The Empire District Electric Company – A Liberty Utility 2017 Annual RES Compliance Report

CONFIDENTIAL

ATTACHMENT 9: RES RETAIL RATE IMPACT

The Empire District Electric Company 2017 RES Filing

The Empire District Electric Company ("Empire") requested that ABB perform modeling for their Electric Utility Renewable Energy Standard (RES) Requirements. The modeling included calculating the retail rate impact per section 5 of Missouri 4 CSR 240-20.100 (the "Rule").

Assumptions:

Rule 5 (B) 1 states that the non-renewable gneration and purchase power portfolio shall be determined by adding, to the utility's existing generation and purchased power resource portfolio excluding all renewable resources, additional non-renewable resources sufficient to meet the utility's needs on a least-cost basis for the next ten (10) years. To achieve this portfolio, ABB removed the following renewables from the 2016 IRP resources; 1) Elk River and Meridian Way Wind – 36 MWs of Accredited Capacity, Ozark Beach Hydro – 16 MWs of Accredited Capacity, 2029 Future Wind – 15 MWs of Accredited Capacity and 2031 Future wind – 22.5 MWs of Accredited Capacity. In addition, the impact of the residential and commercial solar additions that were removed from the load forecast by Itron were added back. To account for the loss of capacity, the 2029 combined cycle was brought on in 2026 and an additional 100 MW combined cycle was added in 2033 in order to maintain a minimum capacity margin of 12%.

Rule 5 (B) 2 states that the RES-compliant portfolio shall be determined by adding to the utility's existing generation and purchased power resource portfolio an amount of least cost renewable resources sufficient to achieve the portfolio requirements set forth in section (2) of this rule and an amount of least-cost non-renewable resources, the combination of which is sufficient to meet the utility's needs for the next ten (10) years. ABB is using the preferred plan (Plan 5) from Empire's latest IRP filing. Plan 5 included renewable resources that meet the RES requirements set forth in section (2). As required by rule 5 (C), rebates made during each calendar year were also included in the cost of generation from renewable energy resouces. 2015-2017 budgeted solar capacity was updated with actual solar rebated operational capacity. The difference between actual and budget was added as a solar resource in order to offset the impact on the load forecast. 2015-2017 budgeted solar rebates paid were also updated for actuals.

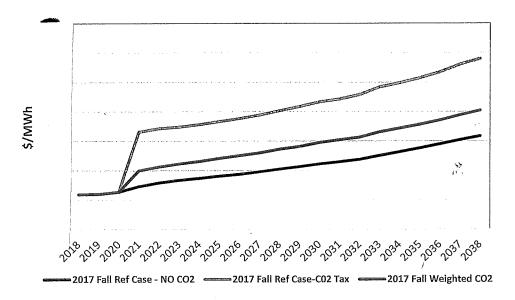
Rule 5 (B) 4 states that the assumptions regarding projected renewable energy resource additions will utilize the most recent electric utility resource planning analysis. Weighting of the greenhouse gas emissions and market prices were developed using ABB's 2017 Fall Midwest Power Reference Case. A 70% weighting was given to the no-carbon tax scenario and 30% to the carbon tax scenario.

Table 1 includes the expected value of costs associated with greenhouse gas emissions used in this analysis. Weighted market prices were developed in ABB's 2017 Fall Reference Case database with modifications that included a weighted carbon tax. Figure 1 includes market prices for the SPP-KSMO market area with the impact of a carbon tax begining in 2021.

Table 1 Expected Value Carbon Tax

	70%	30%	
Year	No Carbon	Fall 2017	Expected
		Ref Case	Value
2017	-		
2018	-		
2019	-		
2020	-		
2021	-		1
2022	-		
2023	-		
2024	-		ļ
2025	-		
2026	-		
2027	-		
2028	-		
2029	-		
2030	-		
2031			
2032			
2033			
2034			
2035			
2036			
2037]

Figure 1 SPP-KSMO 7 x 24 Weighted Market Prices (Nominal \$/MWh)



Results:

The following table shows the 1% calculation for the 10 year average over the succeeding 10-year period required by Rule 5 (B).

Table 2 Annual Revenue Requirements

	2018	2019	2020	2021	i	2022	2023		2024	-	2025	į	2026	1	2027	Total
Actual Spend - 2018-2027																•
Budget - 2018-2027																
Revenue Requirements 2018-2027													•			
Budget % of Revenue Requirements	;									±.		45		221		
Actual % of Revenue Requirements	2.6%	2.5%	2.2%	0.1	%	-0.2%	-0.	4%	-0.89	%	-1.2		-1.5		-3.9%	-0.1%

The following tables summarize the Retail Rate Impact calculation required by Rule 5 (G).

Table 3 2018-2027 RRI Calculation Period

2018-2027 RRI Calculation Period			- :				ï				Y.		Ĺ				ī.				 	
		2018	i.	2019		2020	i	2021	2	022	╝.	2023	į	2024	i	2025	İ	2026	÷	2027		
Baseline Revenue Req (MM\$)																						
Annual 1% (MM\$)																						
Actual Costs	And a second sec																					
Annual Over/(Under)				•																		
Plus Prior Carryover	1	8.45	5		•						L				î		Ī					
Cumulative carryover - over/(under)		17.38	2	25.737		32.823		27.568		19.98:	Ļ	11.23	3	-0.261	Ų	-15.03	2	-31.75	9	-66.265		

Table 4 2019-2028 RRI Calculation Period

2019-2028 RRI Calculation Period											 			
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028		:	Cumul	ative
Baseline Revenue Req (MM\$)					· · · · · · · · · · · · · · · · · · ·			,						
Annual 1% (MM\$)														
									39 %					
Actual Costs	and the same of th													
														-
Annual Over/(Under)	8.356	7.085	5.254	-7.588	-8./4/	-11.494	-14.771	-16.727	-34.506	-33.097				
Plus Prior Carryover	17.382													
Cumulative carryover - over/(under)	25.737	32,823	27,568	19,981	11.233	-0.261	-15.032	-31.759	-66,265	-99.361				

Table 5 2020-2029 RRI Calculation Period

2020-2029 RRI Calculation Period	T												
·	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029		Cumulati	ve
Baseline Revenue Req (MM\$)							•						
Annual 1% (MM\$)													
the side presentation and the extension of the second boundary to th													
Actual Costs													
Annual Over/(Under)	7.085	-5.254	-7.588	-8.747	-11.494	-14.771	-16.727	-34.506	-33.097	-46.231		!	
Plus Prior Carryover	25.737										 		
Cumulative carryover - over/(under)	32.823	27.568	19,981	11.233	-0.261	-15.032	-31.759	-66.265	-99,361	-145,593		i .	

Table 6 2021-2030 RRI Calculation Period

2021-2030 RRI Calculation Period								:					
	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030			Cumulative
Baseline Revenue Req (MM\$)						C30 03#	607 706	707 576	717 000	725 240	10-Vaar "Rudos	af ^{rs}	"Rudget"
Annual 1% (MM\$)													
	- [
	-												
Actual Costs													
A		7.500		47.04	2 2 3 3 3			22 007	ar 335	2 11011			,
Annual Over/(Under) Plus Prior Carryover	-5.254 32.823	-7.588	-8.747	-11.494	-14.771	-16.727	-34,506	-33.097	-45,231	3.948			
Cumulative carryover - over/(under)	27.568	19.981	11.233	-0.261	-15.032	-31.759	-66.265	-99.361	-145.593	-141.645			
0. E. A. (1)													
Table 7 2022-2031 RR	I Calcui	ation	Perio	d									
2022-2031 RRI Calculation Period						· <u>-</u>							
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031			Cumulative
Baseline Revenue Req (MM\$)			-						705 040	ספס סרד	10-Vaar "Rudee	t"	"Budget"
Annual 1% (MM\$)	-												
	•												
actual Costs													
Annual Over/(Under)	-7,588	-8.747	-11,494	-14.771	-16.727	-34.506	-33.097	-46.231	3.948	-18.097		r	1
lus Prior Carryover	27.568					34.300							
Cumulative carryover - over/(under)	19.981	11.233	-0.261	-15.032	-31.759	-66.265	-99.361	-145.593	-141.645	-159.742			
•													
Table 8 2023-2032 RR	I Calcul	ation .	Period	1									
023-2032 RRI Calculation Period													1
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032		1 	Cumulative
Baseline Revenue Req (MM\$)											· ·		
nnual 1% (MM\$)										-			
	Ì												
	e												
ectual Costs													
Annual Over/(Under)	-8,747	-11.494	-14.771	-16.727	-34,506	-33.097	-46.231	3.948	-18.097	29,216		•	
lus Prior Carryover	19.981									· · · · · · · · · · · · · · · · · · ·			
	13.301										and the second s		1
Cumulative carryover - over/(under)	11.233	-0.261	-15.032	-31.759	-66.265	-99.361	-145.593	-141,645	-159.742	-130.526			
Cumulative carryover - over/(under)	11.233				-66.265	-99.361	-145.593	-141,645		-130.526			*
Cumulative carryover - over/(under)	11.233				-66.265	-99.361	-145.593	-141.645	-159,742	-130.526			*
	11.233				-66.265	-99.361	-145.593	-141.645		-130.526			
tumulative carryover-over/(under) Table 9 2024-2033 RRI	11,233 Calcul	ation I	Period	1	,		,		14,				
rumulative carryover - over/(under) able 9 2024–2033 RRI 024-2033 RRI Calculation Period	11.233				-66.265 2028	-99.361 2029	-145.593 2030	2031		-130.526 2033			Cumulative
Tumulative carryover - over/(under) Table 9 2024–2033 RRI 024-2033 RRI Calculation Period kaseline Revenue Req (MM\$)	11,233 Calcul	ation I	Period	1	,		,		14,				Cumulative
Tumulative carryover - over/(under) Table 9 2024–2033 RRI 024-2033 RRI Calculation Period kaseline Revenue Req (MM\$)	11,233 Calcul	ation I	Period	1	,		,		14,				Cumulative
Tumulative carryover - over/(under) Table 9 2024–2033 RRI 024-2033 RRI Calculation Period kaseline Revenue Req (MM\$)	11,233 Calcul	ation I	Period	1	,		,		14,				Cumulative
Fumulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period Raseline Revenue Req (MM\$) Innual 1% (MM\$)	11,233 Calcul	ation I	Period	1	,		,		14,				Cumulative
Cumulative carryover - over/(under)	11,233 Calcul	ation I	Period	1	,		,	2031	14,				Cumulative
Cumulative carryover - over/(under) Fable 9 2024-2033 RRI 024-2033 RRI Calculation Period Baseline Revenue Req (MM\$) Innual 1% (MM\$)	11,233 Calcul	ation I	Period	1	,		,	2031	14,				Cumulative
Cumulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period caseline Revenue Req (MM\$) cannual 1% (MM\$) ctual Costs characteristics ctual Over/(Under) lus Prior Carryover	11.233 I Calcul 2024	ation I	Derioc 2026	2027	2028	2029	2030	2031:	2032	2033			Cumulative
umulative carryover - over/(under) Table 9 2024–2033 RRI 024-2033 RRI Calculation Period asseline Revenue Req (MM\$) nnual 1% (MM\$) ctual Costs nnual Over/(Under) lus Prior Carryover	11.233 I Calcul	ation I	Period	1	2028	2029	2030	2031	2032	2033			Cumulative
umulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period aseline Revenue Req (MM\$) nnual 1% (MM\$) ctual Costs nnual Over/(Under) us Prior Carryover umulative carryover - over/(under)	11.233 I Calcul 2024 11.233 -0.261	2025: -15.032	Derioc 2026	2027	2028	2029	2030	2031:	2032	2033			Cumulative
umulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period aseline Revenue Req (MM\$) nnual 1% (MM\$) ctual Costs nnual Over/(Under) us Prior Carryover umulative carryover - over/(under)	11.233 I Calcul 2024 11.233 -0.261	2025: -15.032	Derioc 2026	2027	2028	2029	2030	2031:	2032	2033			Cumulative
Cumulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period Caseline Revenue Req (MM\$) Cannual 1% (MM\$) Catual Costs	11.233 I Calcul 2024 11.233 -0.261	2025: -15.032	Derioc 2026	2027	2028	2029	2030	2031:	2032	2033			Cumulative
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rumulative carryover - over/(under) Table 9 2024-2033 RRI 024-2033 RRI Calculation Period caseline Revenue Req (MM\$) nnual 1% (MM\$) ctual Costs nnual Over/(Under) lus Prior Carryover umulative carryover - over/(under) Table 10 2025-2034 RI 025-2034 RRI Calculation Period	11.233 I Calcul 2024 11.233 -0.261	2025: -15.032	Derioc 2026	2027	2028	2029	2030	2031:	2032	2033 -107.525	A.Vaar Buile-		Cumulative
Cumulative carryover - over/(under) Table 9 2024-2033 RRI 1024-2033 RRI Calculation Period Raseline Revenue Req (MM\$) Autual 1% (MM\$) Luctual Costs Lumual Over/(Under) Lus Prior Carryover Lumulative carryover - over/(under) Table 10 2025-2034 RI 1025-2034 RRI Calculation Period Raseline Revenue Req (MM\$)	11.233 I Calcul 2024 11.233 0.261	2025: -15.032	2026 -31.759 Peric	2027 -66.265	2028 -99.361	2029 -145.593	2030	2031: . , /	2032	2033 -107.525	^_Vaar [®] Rudoat		
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Cumulative carryover - over/(under) Cable 9 2024-2033 RRI CO24-2033 RRI Calculation Period CO24-2034 RRI Calculation Period CO24-2035 RRI Calculation Period CO25-205	11.233 I Calcul 2024 11.233 0.261	2025: -15.032	2026 -31.759 Peric	2027 -66.265	2028 -99.361	2029 -145.593	2030	2031: . , /	2032	2033 -107.525	n-Yaar "Rudoat		Cumulative
Cumulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period claseline Revenue Req (MM\$) cutual Costs cumual Over/(Under) lus Prior Carryover umulative carryover - over/(under) Cable 10 2025-2034 RI 025-2034 RRI Calculation Period claseline Revenue Req (MM\$) nnual 1% (MM\$)	11.233 I Calcul 2024 11.233 0.261	2025: -15.032	2026 -31.759 Peric	2027 -66.265	2028 -99.361	2029 -145.593	2030	2031: . , /	2032	2033 -107.525	∩-Yaar "Rudoet		Cumulative
Cumulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period Raseline Revenue Req (MM\$) cutual Costs nnual Over/(Under) lus Prior Carryover umulative carryover - over/(under) Cable 10 2025-2034 RI 025-2034 RRI Calculation Period laseline Revenue Req (MM\$)	11.233 I Calcul 2024 11.233 0.261	2025: -15.032	2026 -31.759 Peric	2027 -66.265	2028 -99.361	2029 -145.593	2030	2031: . , /	2032	2033 -107.525	O-Vaar "Rudoet		Cumulative
Cumulative carryover - over/(under) Cable 9 2024-2033 RRI 024-2033 RRI Calculation Period caseline Revenue Req (MM\$) cutual Costs	11.233 I Calcul 2024 11.233 -0.261 RI Calcu	2025: -15.032	2026 -31.759 Peric	2027 -66.265	2028 -99.361	2029 -145.593	2030	2031: . , /	2032	2033 -107.525	O-Vaar "Rudoet		Cumulative
umulative carryover - over/(under) Cable 9 2024-2033 RRI D24-2033 RRI Calculation Period asseline Revenue Req (MM\$) annual 1% (MM\$) citual Costs annual Over/(Under) us Prior Carryover umulative carryover - over/(under) Cable 10 2025-2034 RI D25-2034 RRI Calculation Period asseline Revenue Req (MM\$) asseline Revenue Req (MM\$) annual 1% (MM\$)	11.233 I Calcul 2024 11.233 0.261	2025 -15.032 ulation	2026 -31.759 Peric	2027 -66,265	2028 -99.361 2029	2029 -145.593	2030	2031 	2032	2033 -107.525	^_Vaar "Rudoet		Cumulative

Table 11 2026-2035 RRI Calculation Period

2026-2035 RRI Calculation Period					i						 	
	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035		Cumulative
Baseline Revenue Reg (MM\$)												
Annual 1% (MM\$)												
Actual Costs												
Annual Over/(Under)	-16.727	-34.506	-33.097	-46.251	5.948	-19:097;	- ZA:ZIO	25.001	-4.170	-11,50Z		
Plus Prior Carryover	-15.032					1						
Cumulative carryover - over/(under)	-31.759	-66.265	-99.361	-145,593	-141.645	-159.742	-130.526	-107.525	-111.695	-122.997		

Table 12 2027-2036 RRI Calculation Period

2027-2036 RRI Calculation Period											 	1		
	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036		1	Cumulative	4
Baseline Revenue Req (MM\$)	_													
Annual 1% (MM\$)							-				,			
Actual Costs														
Annual Over/(Under)														
Plus Prior Carryover												1		
Cumulative carryover - over/(under)	-66.265	-99.361 -	145.593 -1	L41.645 -1	59.742	-130.526	-107.525 -	111.695 -		140.017		1		