



DTE Electric Company
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September 12, 2024

Lisa Felice
Executive Secretary
Michigan Public Service Commission
7109 West Saginaw Highway
Lansing, MI 48917

RE: In the matter of the Application of **DTE ELECTRIC COMPANY** for authority to increase its rates, amend its rate schedules and rules governing the distribution and supply of electric energy, and for miscellaneous accounting authority
MPSC Case No. U-21534

Dear Ms. Felice:

The following is attached for paperless electronic filing:

Official Exhibits of the DTE Electric Company admitted into the record on September 4-6, 2024 and September 9-10, 2024:

Exhibits A-46 thru A-54

If you have any questions or concerns with this filing, please contact me at the above referenced number.

Respectfully submitted,

Estella R. Branson

Digitally signed by Estella R.
Branson
Date: 2024.09.12 12:51:03 -04'00'

Estella R. Branson
Senior Paralegal

Enclosure

No	Spend Year	Business Case / Project Name	IT Portfolio/Program	Witness (if multiple)	BCD ID	Cost Estimate Level (if applicable)	U-21534 Capital	Current Cost Estimate Level	Current Capital Level 3 Estimate	Capital Variance %
1	2024	Maximo Engineering Process Automation	Plant & Field	Pankaj Sharma	DMND0001445	Level 2	\$ 3,757,000	Level 3	\$ 3,757,418	0%
2	2024	Enhanced Document Management Capability Projects	Corporate Applications	Pankaj Sharma	DMND0001448	Level 2	\$ 1,218,974	Level 3	\$ 1,218,000	0%
3	2024	Human Resources Applications Health	Corporate Applications	Pankaj Sharma	DMND0001227	Level 2	\$ 250,000	Level 3	\$ 250,086	0%
4	2024	Network Access Control	Information Protection Security	Pankaj Sharma	DMND0001647	Level 2	\$ 500,000	Level 3	\$ 500,000	0%
5	2024	Tower and Lighting Inspections and Repairs	Infrastructure Operations	Pankaj Sharma	DMND0001338	Level 2	\$ 150,000	Level 3	\$ 150,000	0%
6	2024	Core ERP Data Archiving	Corporate Applications	Pankaj Sharma	DMND0001217	Level 2	\$ 750,000	Level 3	\$ 750,007	0%
7	2024	Production Growth	Corporate Applications	Pankaj Sharma	DMND0001231	Level 2	\$ 893,262	Level 3	\$ 893,262	0%
8	2024	Storm Simulation Lab	Plant & Field	Pankaj Sharma	DMND0003237	Level 2	\$ 6,495,323	Level 3	\$ 6,500,000	0%
9	2024	Ransomware Recovery	Information Protection Security	Pankaj Sharma	DMND0001360	Level 2	\$ 500,000	Level 3	\$ 500,000	0%
10	2024	Powerley Customer Platform Application Health	Customer Service	Pankaj Sharma	DMND0002599	Level 2	\$ 500,001	Level 3	\$ 500,000	0%
11	2024	Advance Metering Infrastructure (AMI) Application Health	Plant & Field	Pankaj Sharma	DMND0001365	Level 2	\$ 1,382,000	Level 3	\$ 1,381,370	0%
12	2024	Data Center Modernization and Optimization	Infrastructure Operations	Pankaj Sharma	DMND0001339	Level 2	\$ 2,100,000	Level 3	\$ 2,100,000	0%
13	2024	Enterprise Applications Health	Corporate Applications	Pankaj Sharma	DMND0001221	Level 2	\$ 740,000	Level 3	\$ 739,999	0%
14	2024	Vulnerability Scan tool	Information Protection Security	Pankaj Sharma	DMND0001723	Level 2	\$ 425,000	Level 3	\$ 425,240	0%
15	2024	Endpoint Operating System and Hardware Upgrade	Infrastructure Operations	Pankaj Sharma	DMND0001855	Level 2	\$ 2,800,000	Level 3	\$ 2,800,000	0%
16	2024	Fuel Supply Application Health	Plant & Field	Pankaj Sharma	DMND0001437	Level 2	\$ 469,000	Level 3	\$ 471,208	0%
17	2024	Documentum (EDM) Application Health	Corporate Applications	Pankaj Sharma	DMND0001382	Level 2	\$ 392,000	Level 3	\$ 391,502	0%
18	2024	Cloud Health and Safety	Corporate Applications	Pankaj Sharma	DMND0001490	Level 2	\$ 2,518,000	Level 3	\$ 2,517,981	0%
19	2024	ITS ADMS Application Health	Plant & Field	Pankaj Sharma	DMND0002490	Level 2	\$ 1,069,611	Level 3	\$ 1,069,658	0%
20	2024	Endpoint End of Life Electric Support Services	Infrastructure Operations	Pankaj Sharma	DMND0001321	Level 2	\$ 853,000	Level 3	\$ 854,307	0%
21	2024	Network Advanced Metering Infrastructure Support	Infrastructure Operations	Pankaj Sharma	DMND0001330	Level 2	\$ 2,200,000	Level 3	\$ 2,200,000	0%
22	2024	Security Infrastructure Growth and End of Life	Infrastructure Operations	Pankaj Sharma	DMND0001315	Level 2	\$ 1,400,000	Level 3	\$ 1,400,000	0%
23	2024	Fuel Supply-Plant Fuel Management System	Plant & Field	Pankaj Sharma	DMND0001440	Level 2	\$ 2,127,343	Level 3	\$ 2,126,939	0%
24	2024	Data Power Replacement Phase 2	Infrastructure Operations	Pankaj Sharma	DMND0001645	Level 2	\$ 650,654	Level 3	\$ 649,899	0%
25	2024	Transparency Electric Data	Corporate Applications	Pankaj Sharma	DMND0003095	Level 2	\$ 1,816,520	Level 3	\$ 1,816,900	0%
26	2024	Organizational Management Optimization	Corporate Applications	Pankaj Sharma	DMND0001617	Level 2	\$ 500,671	Level 3	\$ 500,210	0%
27	2024	System for Fossil Generation for Coal and Gas	Plant & Field	Pankaj Sharma	DMND0001436	Level 2	\$ 415,000	Level 3	\$ 415,225	0%
28	2024	Compute and Storage Cache Refresh	Infrastructure Operations	Pankaj Sharma	DMND0001646	Level 2	\$ 528,000	Level 3	\$ 526,919	0%
29	2024	Enterprise Monitoring Strategy Operational Growth	Infrastructure Operations	Pankaj Sharma	DMND0001322	Level 2	\$ 600,000	Level 3	\$ 600,000	0%
30	2024	Backup Environmental Growth	Infrastructure Operations	Pankaj Sharma	DMND0001317	Level 2	\$ 624,000	Level 3	\$ 623,995	0%
31	2024	Dell Storage Hardware Refresh	Infrastructure Operations	Pankaj Sharma	DMND0003143	Level 2	\$ 255,000	Level 3	\$ 255,254	0%
32	2024	Cable Routing Application (CRA) Replatform	Plant & Field	Pankaj Sharma	DMND0001431	Level 2	\$ 614,000	Level 3	\$ 613,808	0%
33	2024	Cyber Excellence Plan (CEP) Program	Information Protection Security	Pankaj Sharma	DMND0001468	Level 2	\$ 300,000	Level 3	\$ 299,509	0%
34	2024	Network Hardening and Operations	Infrastructure Operations	Pankaj Sharma	DMND0001334	Level 2	\$ 400,000	Level 3	\$ 399,815	0%
35	2024	Corporate Services Application Health	Corporate Applications	Pankaj Sharma	DMND0001218	Level 2	\$ 779,000	Level 3	\$ 778,965	0%
36	2024	Network Reliability and Monitoring	Plant & Field	Pankaj Sharma	DMND0001396	Level 2	\$ 750,000	Level 3	\$ 750,206	0%
37	2024	External Secure File Transfer Replacement	Infrastructure Operations	Pankaj Sharma	DMND0001641	Level 2	\$ 355,000	Level 3	\$ 355,000	0%
38	2024	Storm Cloud	Infrastructure Operations	Pankaj Sharma	DMND0003227	Level 2	\$ 9,999,998	Level 3	\$ 10,000,000	0%
39	2024	Field Communications Network FCN Growth and Upgrade	Infrastructure Operations	Pankaj Sharma	DMND0001324	Level 2	\$ 300,000	Level 3	\$ 300,000	0%
40	2024	Wide Area Network and Wireless Local Area Network Exp	Infrastructure Operations	Pankaj Sharma	DMND0001732	Level 2	\$ 600,000	Level 3	\$ 600,000	0%
41	2024	Nuclear Generation Business Systems Replacement	Plant & Field	Pankaj Sharma	DMND0001447	Level 2	\$ 650,000	Level 3	\$ 651,359	0%
42	2024	Core ERP Stacks and Packs	Corporate Applications	Pankaj Sharma	DMND0001215	Level 2	\$ 1,668,000	Level 3	\$ 1,667,976	0%
43	2024	Advance Metering Infrastructure Field Collection System	Plant & Field	Pankaj Sharma	DMND0001366	Level 2	\$ 1,682,000	Level 3	\$ 1,681,866	0%
44	2024	Migrate IVR to the cloud	Customer Service	Pankaj Sharma	DMND0001538	Level 2	\$ 2,570,000	Level 3	\$ 2,562,557	0%
45	2024	Network Data Center End of Life Project	Infrastructure Operations	Pankaj Sharma	DMND0001331	Level 2	\$ 450,000	Level 3	\$ 449,638	0%
46	2024	IT for IT Application Health	Information Technology for IT	Pankaj Sharma	DMND0001350	Level 2	\$ 16,622,000	Level 3	\$ 16,613,763	0%
47	2024	Automated Application Monitoring Application Health	Customer Service	Pankaj Sharma	DMND0001243	Level 2	\$ 380,000	Level 3	\$ 395,513	-4%
48	2024	Closed Loop COCL Application Health	Customer Service	Pankaj Sharma	DMND0001255	Level 2	\$ 760,000	Level 3	\$ 800,517	-5%
49	2024	Customer Information Technology (CIT) Configuration Ma	Customer Service	Pankaj Sharma	DMND0001253	Level 2	\$ 1,920,000	Level 3	\$ 2,020,572	-5%
50	2024	Customer Legacy Application Health	Customer Service	Pankaj Sharma	DMND0001264	Level 2	\$ 450,000	Level 3	\$ 470,396	-5%
51	2024	Supporting capabilities Test data and test data mgmt	Customer Service	Pankaj Sharma	DMND0001491	Level 2	\$ 500,000	Level 3	\$ 527,350	-5%
52	2024	Conference Room Audio Video Support	Infrastructure Operations	Pankaj Sharma	DMND0001318	Level 2	\$ 500,000	Level 3	\$ 488,959	2%
53	2024	DO Business Warehouse (DOBW) Replacement	Plant & Field	Pankaj Sharma	DMND0001376	Level 2	\$ 250,000	Level 3	\$ 242,715	3%
54	2024	IPS Operations PAW and DC Replacement	Information Protection Security	Pankaj Sharma	DMND0002264	Level 2	\$ 321,125	Level 3	\$ 316,958	1%
55	2024	Cloud Platform Enterprise Agreement	Customer Service	Pankaj Sharma	DMND0002646	Level 2	\$ 750,600	Level 3	\$ 791,658	-5%
56	2024	Renewable Operations Application Health	Plant & Field	Pankaj Sharma	DMND0001995	Level 2	\$ 120,000	Level 3	\$ 124,091	-3%
57	2024	DTE Electric Generation Capacity Application Health	Plant & Field	Pankaj Sharma	DMND0001424	Level 2	\$ 570,000	Level 3	\$ 565,318	1%

58	2024	Endpoint Protection	Information Protection Security	Pankaj Sharma	DMND0001359	Level 2	\$	314,000	Level 3	\$	331,634	-6%
59	2024	DTE Electric Utility Network (UN)	Plant & Field	Pankaj Sharma	DMND0001466	Level 2	\$	370,799	Level 3	\$	382,082	-3%
60	2024	Azure Active Directory Federation Implementation	Information Protection Security	Pankaj Sharma	DMND0001342	Level 2	\$	440,000	Level 3	\$	466,646	-6%
61	2024	Financial Applications Health	Corporate Applications	Pankaj Sharma	DMND0001224	Level 2	\$	250,000	Level 3	\$	263,675	-5%
62	2024	Supervisory Control and Data Acquisition (SCADA) System	Plant & Field	Pankaj Sharma	DMND0001395	Level 2	\$	520,000	Level 3	\$	558,416	-7%
63	2024	Business Planning and Development (BPD) and Electric Sa	Customer Service	Pankaj Sharma	DMND0001246	Level 2	\$	800,000	Level 3	\$	843,760	-5%
64	2024	MIGreenPower Program Stabilization	Customer Service	Pankaj Sharma	DMND0001759	Level 2	\$	1,550,000	Level 3	\$	1,634,785	-5%
65	2024	Digital Channels Transformation Program	Customer Service	Pankaj Sharma	DMND0001251	Level 2	\$	4,420,000	Level 3	\$	4,661,774	-5%
66	2024	Microwave End Of Life	Infrastructure Operations	Pankaj Sharma	DMND0001329	Level 2	\$	402,000	Level 3	\$	399,964	1%
67	2024	DO Equipment Engineering Transformer Database	Plant & Field	Pankaj Sharma	DMND0001381	Level 2	\$	374,027	Level 3	\$	359,049	4%
68	2024	Recovery Manager for AD - Disaster Recovery Edition	Information Protection Security	Pankaj Sharma	DMND0002692	Level 2	\$	652,970	Level 3	\$	688,695	-5%
69	2024	Production Growth	Plant & Field	Pankaj Sharma	DMND0001400	Level 2	\$	1,485,346	Level 3	\$	1,528,479	-3%
70	2024	Cyber Security Defense Center (CSDC) Growth and LifeCy	Information Protection Security	Pankaj Sharma	DMND0001303	Level 2	\$	300,000	Level 3	\$	298,190	1%
71	2024	Virtual Desktop Infrastructure End of Life	Infrastructure Operations	Pankaj Sharma	DMND0002397	Level 2	\$	980,000	Level 3	\$	1,028,319	-5%
72	2024	ITS-SRS Application Health	Plant & Field	Pankaj Sharma	DMND0002489	Level 2	\$	1,057,374	Level 3	\$	1,019,478	4%
73	2024	Enterprise Resource Planning	Corporate Applications	Pankaj Sharma	0001213, DMND0	Level 2	\$	1,108,000	Level 3	\$	1,116,098	-1%
74	2024	Distribution Operations Application Health	Plant & Field	Pankaj Sharma	DMND0001380	Level 2	\$	1,180,000	Level 3	\$	1,198,902	-2%
75	2024	Mobile Device Management (MDM)	Infrastructure Operations	Pankaj Sharma	DMND0001720	Level 2	\$	340,000	Level 3	\$	310,000	9%
76	2024	Firewall Threat Protection	Infrastructure Operations	Pankaj Sharma	DMND0001746	Level 2	\$	600,000	Level 3	\$	587,752	2%
77	2024	Customer Digital Channels and Self Service Program	Customer Service	Pankaj Sharma	0001269, DMND0	Level 2	\$	2,770,000	Level 3	\$	2,921,519	-5%
78	2024	Customer Relationship and Billing Program	Customer Service	Pankaj Sharma	0001259, DMND0	Level 2	\$	1,750,000	Level 3	\$	1,837,288	-5%

Total \$ 104,806,596
Staff proposed 20% Capital disallowance \$ 20,961,319

Q1. Refer to Exhibit A-12, Schedule B5.7.1. For each project of \$3.0 million or greater in 2024 and 2025, please:

a) Describe the project, what is being done, and why it is necessary to undertake each project.

A1. The requested information for Schedule B5.7.1, IT projects of \$3.0 million or greater in 2024 and 2025 can be found using the references listed below:

Schedule B5.7.1 2024-2025 Projects (\$3million or greater)

2024-2025 Projects (\$3 million or greater)	Investment Category	Witness Sharma's Direct Testimony Reference	Exhibit A- 24 N1 Reference
Cloud Health and Safety	Return to Health	PS-27 and PS-28	Pages 42 through 44
Enhanced Document Management Capability Projects	Strategic	PS-30 and PS-31	Pages 56 through 58

Q2. Refer to Exhibit A-12, Schedule B5.7.1. For each project of \$3.0 million or greater in 2024 and 2025, please:

a) Provide the project phases of development with related timeline and the identify the current phase of development (i.e., needs identification, initial concept, system requirements, implementation, completed) and the target in-service date.

A2. The requested information for Schedule B5.7.1 IT projects of \$3.0 million or greater in 2024 and 2025 can be found using the references listed below:

Cloud Health and Safety Timeline

Cloud Health and Safety is in build phase and target in-service date is 11/1/2024		
Activity	Target Start Date	Target End Date
Initiation	7/8/2024	7/12/2024
Design	7/15/2024	8/9/2024
Build	8/12/2024	10/4/2024
Validate	10/7/2024	10/25/2024
Deployment	10/28/2024	11/1/2024
Hypercare	11/4/2024	11/15/2024

Enhanced Document Management Capability Timeline

Enhanced Document Management Capability is in requirements analysis phase and target in-service date is 1/31/2025		
Activity	Target Start Date	Target End Date
Requirement Analysis	8/1/2024	9/6/2024
Design and Environment setup	8/19/2024	9/13/2024
Build	9/15/2024	11/30/2024
Validate - System Testing, User Testing and Performance Testing	11/1/2024	12/31/2024
Migration	8/26/2024	1/31/2024
Deployment	1/20/2025	1/31/2025
Hypercare	2/1/2025	2/28/2025

Q3. Refer to Exhibit A-12, Schedule B5.7.1. For each project of \$3.0 million or greater in 2024 and 2025, please:

b) Provide the project cost by year from inception to completion.

A3. Cloud Health and Safety project capital investment is in the Return to Health category. As described in the DTE Five-Year IT Plan 2021-2025 filed in Docket No. U-20642, section 3.C “Return-to-Health” investment category represents non-discretionary spend, to update systems which are in critical health or end-of life. These projects require recurring annual investments to continue to sustain or address critical health, or end-of-life. Please see below table for the requested information:

Project cost by year

2024-2025 Projects (\$3 million or greater)	Investment Category	Witness Sharma’s Direct Testimony Reference	Cost by year from inception to completion
Cloud Health and Safety	Return to Health	PS-27 and PS-28	Annual
Enhanced Document Management Capability Projects	Strategic	PS-30 and PS-31	\$4,176,000

Q4. Refer to Exhibit A-12, Schedule B5.7.1. For each project of \$3.0 million or greater in 2024 and 2025, please:

c) Provide a copy of the cost/benefit analysis showing each project was economically justified”.

A4. The requested information for Schedule B5.7.1 IT projects of \$3.0 million or greater in 2024 and 2025 can be found using the references listed below:

2024-2025 Projects (\$3 million or greater)	Investment Category	Witness Sharma’s Direct Testimony Reference
Cloud Health and Safety	Return to Health	PS-27 and PS-28
Enhanced Document Management Capability Project	Strategic	PS-30 and PS-31

Cloud Health and Safety project is nondiscretionary (Return-to-Health) category

As outlined in witness Sharma direct testimony Q14(PS-7 through PS-9), nondiscretionary Regulatory/Compliance, Sustainment, and Return-to-Health projects are considered “must do” and, therefore, do not require a cost benefit analysis.

Enhanced Document Management Capability Project is Strategic Category

Please refer to Exhibit A-24 N1 page 56 -58 for the Project Prioritization Score (PPS) and project benefits. used for prioritization as part of Annual planning cycle (APC).

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-3.122

Respondent: P. Sharma

Page: 1 of 1

Question: 122. Refer to Exhibit A-12, Schedule B5.7, pages 1, 2 and 3, on IT projects. Please expand these schedules to include the same actual information for each year 2018 to 2023 and provide it in Excel.

Answer: Please see attached excel 'U-21534 AGDE-3.122 A-12 B5.7 2018-2023 actuals.xlsx'

Attachment: U-21534 AGDE-3.122 A-12 B5.7 2018-2023 actuals.xlsx

Line No.	Description	2018 Actuals (\$000)	2019 Actuals (\$000)	2020 Actuals (\$000)	2021 Actuals (\$000)	2022 Actuals (\$000)	2023 Actuals (\$000)
1	IT Expenditures by Portfolio:						
2	Corporate Applications	4,549	3,637	6,240	16,880	17,087	10,736
3	Customer Service (Sustainment and Return to Health)	18,683	18,620	24,046	23,524	21,604	27,253
4	Customer Service (Strategic, Enhancements & Compliance)	4,890	3,005	14,349	15,076	62,082	45,720
5	Plant & Field	7,802	20,191	19,260	33,673	58,910	25,035
6	Information Technology for IT	2,777	5,417	2,736	16,673	5,153	3,205
7	Information Protection Security	480	1,321	1,975	1,870	6,063	3,924
8	Infrastructure Operations	13,422	11,889	22,893	27,288	45,087	53,858
9	Enterprise Data Analytics	-	468	6,616	4,771	5,521	4,570
10	Innovations	331	7	3,684	2,227	2,789	3,043
11	Total	52,935	64,555	101,800	141,982	224,295	177,344
** Customer Service (Strategic, Enhancements & Compliance) on Line 4 is sponsored by Witness Hatsios							
12	Total Expenditures by Major Category:						
13	Regulatory/Compliance	5,004	3,082	8,369	6,089	22,856	14,113
14	Sustainment	30,499	26,753	37,229	49,784	26,682	63,100
15	Return-to-Health	9,413	21,915	26,910	38,283	69,494	31,876
16	IT Enhancements	1,916	1,066	7,944	9,151	19,431	7,880
17	Strategic	4,744	8,176	14,161	31,386	83,094	60,081
18	IT Projects<\$250K	1,358	3,563	7,187	7,289	2,738	295
19	Total	52,935	64,555	101,800	141,982	224,295	177,344

Line No.	Description	2018 Actuals (\$000)	2019 Actuals (\$000)	2020 Actuals (\$000)	2021 Actuals (\$000)	2022 Actuals (\$000)	2023 Actuals (\$000)
1	Regulatory/Compliance						
2	Corporate Applications	-	-	-	-	1,138	1,490
3	Customer Service	4,890	3,005	8,252	5,650	21,107	11,668
4	Plant & Field	-	-	-	-	-	-
5	Information Technology for IT	0	0	0	0	0	0
7	Information Protection Security	-	-	-	-	-	640
8	Infrastructure Operations	114	77	117	439	612	315
9	Enterprise Data Analytics	0	0	0	0	0	0
6	Innovations	0	0	0	0	0	0
10	Total Regulatory/Compliance	5,004	3,082	8,369	6,089	22,856	14,113
11							
12	Sustainment						
13	Corporate Applications	2,633	2,498	4,455	5,421	3,571	2,799
14	Customer Service	18,683	17,188	10,190	19,232	6,881	13,153
15	Plant & Field	3,705	3,927	8,042	7,626	14,369	7,264
16	Information Technology for IT	-	633	1,449	14,369	1,669	1,783
18	Information Protection Security	0	0	0	0	0	0
19	Infrastructure Operations	5,478	2,039	13,093	3,134	193	38,101
20	Enterprise Data Analytics	-	468	-	2	-	-
17	Innovations	0	0	0	0	0	0
21	Total Sustainment	30,499	26,753	37,229	49,784	26,682	63,100
22							
23	Return-to-Health						
24	Corporate Applications	-	-	-	-	-	-
25	Customer Service	-	1,432	13,856	4,292	14,080	14,010
26	Plant & Field	1,457	11,265	5,179	14,637	27,779	11,474
27	Information Technology for IT	0	0	0	0	0	0
29	Information Protection Security	431	419	483	263	157	369
30	Infrastructure Operations	7,525	8,799	7,392	19,091	27,477	6,023
31	Enterprise Data Analytics	0	0	0	0	0	0
28	Innovations	0	0	0	0	0	0
32	Total Return-to-Health	9,413	21,915	26,910	38,283	69,494	31,876
33							
34	IT Enhancements						
35	Corporate Applications	1,916	1,064	200	925	1,938	218
36	Customer Service	-	-	-	-	7,422	2,032
37	Plant & Field	-	-	11	728	1,540	-
38	Information Technology for IT	-	-	-	622	254	115
40	Information Protection Security	-	-	13	24	454	149
41	Infrastructure Operations	-	2	1,104	2,091	2,302	796
42	Enterprise Data Analytics	-	-	6,616	4,761	5,521	4,570
39	Innovations	0	0	0	0	0	0
43	Total IT Enhancements	1,916	1,066	7,944	9,151	19,431	7,880
44							
45	Strategic						
46	Corporate Applications	-	-	-	9,946	10,158	6,159
47	Customer Service	-	-	3,133	8,680	33,210	31,937
48	Plant & Field	2,323	3,633	3,758	7,144	14,726	6,261
49	Information Technology for IT	1,736	2,940	1,221	-	2,523	1,307
51	Information Protection Security	49	902	1,177	1,107	5,195	2,751
52	Infrastructure Operations	305	694	1,188	2,282	14,491	8,623
53	Enterprise Data Analytics	0	0	0	0	0	0
50	Innovations	331	7	3,684	2,227	2,789	3,043
54	Total Strategic	4,744	8,176	14,161	31,386	83,094	60,081
55							
56	IT Projects<\$250K						
57	Corporate Applications	-	75	1,585	588	283	70
58	Customer Service	-	-	2,964	746	985	174
59	Plant & Field	317	1,366	2,270	3,538	496	37
60	Information Technology for IT	1,041	1,844	66	1,682	706	1
62	Information Protection Security	-	-	302	476	256	14
63	Infrastructure Operations	-	278	-	251	12	-
64	Enterprise Data Analytics	0	0	0	8	0	0
61	Innovations	0	0	0	0	0	0
65	Total IT Projects<\$250K	1,358	3,563	7,187	7,289	2,738	295
66							
67	Total Information Technology	52,935	64,555	101,800	141,982	224,295	177,344

Line No.	Description	2018 Actuals (\$000)	2019 Actuals (\$000)	2020 Actuals (\$000)	2021 Actuals (\$000)	2022 Actuals (\$000)	2023 Actuals (\$000)
1	Shared Asset Expenditures						
2	Corporate Applications	4,549	3,637	6,240	16,880	17,087	10,728
3	Plant & Field	1,457	4,430	4,590	9,260	7,237	9,475
4	Information Technology for IT	2,777	5,417	2,736	16,673	5,153	3,205
5	Information Protection Security	480	1,321	1,975	1,870	6,063	3,924
6	Infrastructure Operations	7,403	10,101	20,983	21,919	36,190	49,018
7	Enterprise Data Analytics	-	468	6,616	4,771	5,521	4,570
8	Innovations	331	7	3,684	2,227	2,789	3,043
9	Subtotal Corporate Support IT	16,997	25,381	46,824	73,600	80,039	83,964
10	Customer Service - (Sustainment and Return to Health)	18,683	18,508	23,738	20,545	15,252	22,017
11	Customer Service - (Strategic, Enhancements & Compliance)	4,890	3,005	6,108	10,396	28,398	21,476
12	Subtotal Customer Service IT	23,573	21,513	29,846	30,941	43,650	43,493
13	Grand Totals	40,571	46,894	76,671	104,541	123,689	127,456

Staff Analysis comparing Annual costs									Company's Analysis comparing costs within 36 month period ending Dec 31, 2024					
Exh. A-24 N3 Line No.	Spend Year	Business Case Name	IT Portfolio	Total Projected IT Capital Cost (\$)	Cost Estimate Level	Actual Cost	Difference Between Total Projected IT Capital Cost Vs. Actual Cost	Percent Difference	Overall project cost Approved U-21297	Overall project cost submitted for U- 21534	Difference Between Approved U-21297 and Requested in U- 21534	Overall Variance (Approved in U- 21297 Vs. Requested U-21534)	Variance category (Variance within 36 month period ending Dec 31, 2024)	Reason Details (Variance within 36 month period ending Dec 31, 2024)
1	2022	Core ERP Stacks and Packs (2021-25)	Corporate Applications	\$ 1,668,123	Level 3	\$1,138,000	-\$530,123	-31.78%	\$ 4,399,400	\$ 4,243,000	\$ (156,400)	-4%	Within the variance allowance	Within the variance allowance
4	2022	Corporate Services Application Health	Corporate Applications	\$ 788,157	Level 3	\$481,000	-\$307,157	-38.97%	\$ 2,061,557	\$ 1,767,000	\$ (294,557)	-14%	Within the variance allowance	Within the variance allowance
7	2022	Enterprise Applications Health	Corporate Applications	\$ 485,000	Level 3	\$385,000	-\$100,000	-20.62%	\$ 1,611,400	\$ 1,491,000	\$ (120,400)	-7%	Within the variance allowance	Within the variance allowance
19	2022	Production Growth	Corporate Applications	\$ 611,000	Level 3	\$515,000	-\$96,000	-15.71%	\$ 2,199,800	\$ 1,925,000	\$ (274,800)	-12%	Within the variance allowance	Within the variance allowance
30	2022	SuccessFactors Program	Corporate Applications	\$ 400,000	Level 3	\$187,000	-\$213,000	-53.25%	\$ 659,600	\$ 516,000	\$ (143,600)	-22%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U- 21534
103	2022	Advanced Analytics AA use cases Implementation	Customer Service (Hatsios)	\$ 1,365,442	Level 3	\$1,131,000	-\$234,442	-17.17%	\$ 563,000	\$ 1,588,000	\$ 1,025,000	182%	Under recovery greater than 20%	Partial Disallowance in U- 21297
72	2022	Agency Web Site AGW Rebuild	Customer Service	\$ 2,920,000	Level 3	\$2,669,000	-\$251,000	-8.60%	\$ 2,920,000	\$ 4,513,000	\$ 1,593,000	55%	Under recovery greater than 20%	Provided in Witness Sharma testimony for Instant case U- 21534
119	2022	API Integration Security Gateway and API Layer	Customer Service (Hatsios)	\$ 1,550,000	Level 3	\$80,000	-\$1,470,000	-94.84%	\$ -	\$ 100,000	\$ 100,000	100%	Under recovery greater than 20%	Full Disallowance, project had been initiated
113	2022	Automated Application Monitoring Enhancement	Customer Service (Hatsios)	\$ 1,630,000	Level 3	\$1,513,000	-\$117,000	-7.18%	\$ 3,095,600	\$ 1,818,000	\$ (1,277,600)	-41%	Over Recovery greater than 20%	Provided in Witness Hatsios's testimony for Instant case U- 21534 - Schedule Shift to 2025
44	2022	Business Planning and Development (BPD) and Electric Sales & Marketing (ESM) Application Health	Customer Service	\$ 640,000	Level 3	\$386,000	-\$254,000	-39.69%	\$ 1,894,000	\$ 2,037,000	\$ 143,000	8%	Within the variance allowance	Within the variance allowance
52	2022	Cloud Infrastructure and Supporting Capabilities	Customer Service	\$ 500,000	Level 3	\$221,000	-\$279,000	-55.80%	\$ 500,000	\$234,000	\$ (266,000)	-53%	Within the variance allowance	Within the variance allowance
77	2022	Contact Center Infrastructure	Customer Service	\$ 2,040,000	Level 3	\$1,778,000	-\$262,000	-12.84%	\$ 2,040,000	\$ 2,441,000	\$ 401,000	20%	Within the variance allowance	Within the variance allowance
129	2022	Customer Closed Loop Development	Customer Service (Hatsios)	\$ 500,000	Level 3	\$314,000	-\$186,000	-37.20%	\$ 1,200,000	\$ 1,838,000	\$ 638,000	53%	Under recovery greater than 20%	Partial Disallowance in U- 21297
53	2022	Customer Digital Channels and Self Service Program	Customer Service	\$ 1,600,000	Level 3	\$1,550,000	-\$50,000	-3.13%	\$ 5,586,935	\$ 6,539,000	\$ 952,065	17%	Within the variance allowance	Within the variance allowance
56	2022	Customer Information Technology (CIT) Configuration Management	Customer Service	\$ 810,000	Level 3	\$540,000	-\$270,000	-33.33%	\$ 3,131,039	\$ 3,034,374	\$ (96,665)	-3%	Within the variance allowance	Within the variance allowance
106	2022	Customer Legacy Applications Enhancement	Customer Service (Hatsios)	\$ 980,000	Level 3	\$868,000	-\$112,000	-11.43%	\$ 980,000	\$ 832,000	\$ (148,000)	-15%	Within the variance allowance	Within the variance allowance
131	2022	Customer Service Communications	Customer Service (Hatsios)	\$ 1,000,000	Level 3	\$0	-\$1,000,000	-100.00%	\$ 3,355,000	\$ 3,852,000	\$ 497,000	15%	Within the variance allowance	Within the variance allowance
74	2022	Digital Channels Transformation Program	Customer Service	\$ 1,980,000	Level 3	\$502,000	-\$1,478,000	-74.65%	\$ 7,779,118	\$ 8,724,000	\$ 944,882	12%	Within the variance allowance	Within the variance allowance
79	2022	Distributed Generation Upgrades	Customer Service	\$ 3,180,000	Level 3	\$3,175,000	-\$5,000	-0.16%	\$ 3,180,000	\$ 3,235,000	\$ 55,000	2%	Within the variance allowance	Within the variance allowance
139	2022	Field Service Management Billing & Metering	Customer Service (Hatsios)	\$ 885,000	Level 3	\$831,000	-\$54,000	-6.10%	\$ 885,000	\$ 881,000	\$ (4,000)	0%	Within the variance allowance	Within the variance allowance
138	2022	Field Service Management for RM&P	Customer Service (Hatsios)	\$ 1,540,000	Level 3	\$1,534,000	-\$6,000	-0.39%	\$ 1,540,000	\$ 1,630,000	\$ 90,000	6%	Within the variance allowance	Within the variance allowance
140	2022	High Volume IVR Overflow	Customer Service (Hatsios)	\$ 340,000	Level 3	\$0	-\$340,000	-100.00%	\$ 600,000	\$ 23,000	\$ (577,000)	-96%	Within the variance allowance	Within the variance allowance
141	2023	High Volume IVR Overflow	Customer Service (Hatsios)	\$ 260,000	Level 3	\$23,000	-\$237,000	-91.15%				-96%	Within the variance allowance	Within the variance allowance
108	2022	IT Application Environments Enhancement	Customer Service (Hatsios)	\$ 300,000	Level 3	\$164,000	-\$136,000	-45.33%	\$ 905,600	\$ 484,000	\$ (421,600)	-47%	Over Recovery greater than 20%	Provided in Witness Hatsios's testimony for Instant case U- 21534 - Efficiency Gains
144	2022	Journey Work Product Transformation Teams	Customer Service (Hatsios)	\$ 6,872,000	Level 3	\$6,744,000	-\$128,000	-1.86%	\$ 6,872,000	\$ 6,743,792	\$ (128,208)	-2%	Within the variance allowance	Within the variance allowance
147	2022	MIGP - Integrate DTE Insight	Customer Service (Hatsios)	\$ 183,000	Level 3	\$169,000	-\$14,000	-7.65%	\$ 180,000	\$ 169,000	\$ (11,000)	-6%	Within the variance allowance	Within the variance allowance
152	2022	Platform Integration Component	Customer Service (Hatsios)	\$ 1,550,000	Level 3	\$1,048,000	-\$502,000	-32.39%	\$ 1,550,000	\$ 1,259,000	\$ (291,000)	-19%	Within the variance allowance	Within the variance allowance
94	2022	Regulatory Compliance	Customer Service (Hatsios)	\$ 1,500,000	Level 3	\$836,000	-\$664,000	-44.27%	\$ 6,021,400	\$ 6,393,000	\$ 371,600	6%	Within the variance allowance	Within the variance allowance
116	2022	SAP Cloud Platform - Foundational Additions	Customer Service (Hatsios)	\$ 400,000	Level 3	\$102,000	-\$298,000	-74.50%	\$ 400,000	\$ 142,000	\$ (258,000)	-65%	Within the variance allowance	Within the variance allowance

156	2022	SIP in Call Center	Customer Service (Hatsios)	\$ 200,000	Level 3	\$0	-\$200,000	-100.00%	\$ 1,688,000	\$ 856,000	\$ (832,000)	-49%	Over Recovery greater than 20%	Provided in Witness Hatsios's for Instant case U-21534 - Efficiency Gains
157	2023	SIP in Call Center	Customer Service (Hatsios)	\$ 1,487,500	Level 3	\$856,000	-\$631,500	-42.45%				-49%	Over Recovery greater than 20%	Provided in Witness Hatsios's for Instant case U-21534 - Efficiency Gains
159	2022	Social Technologies	Customer Service (Hatsios)	\$ 170,000	Level 3		-\$170,000	-100.00%	\$ 6,000	\$ -	\$ (6,000)	-100%	Within the variance allowance	Within the variance allowance
160	2023	Social Technologies	Customer Service (Hatsios)	\$ 30,000	Level 3		-\$30,000	-100.00%				-100%	Within the variance allowance	Within the variance allowance
158	2022	Speech Analytics	Customer Service (Hatsios)	\$ 1,173,000	Level 3	\$1,145,000	-\$28,000	-2.39%	\$ 1,173,000	\$ 1,117,000	\$ (56,000)	-5%	Within the variance allowance	Within the variance allowance
117	2022	Supporting Capabilities Test Data and Test Data Management	Customer Service (Hatsios)	\$ 1,170,000	Level 3	\$953,000	-\$217,000	-18.55%	\$ 1,170,000	\$ 877,000	\$ (293,000)	-25%	Over Recovery greater than 20%	Provided in Witness Hatsios's for Instant case U-21534 - Efficiency Gains
164	2022	Advance Metering Infrastructure (AMI) Application Health	Plant and Field	\$ 1,390,000	Level 3	\$801,000	-\$589,000	-42.37%	\$ 3,666,200	\$ 4,430,561	\$ 764,361	21%	Under recovery greater than 20%	Partial Disallowance in U-21297
167	2022	ClickSoft Application Health	Plant and Field	\$ 100,000	Level 3	\$2,000	-\$98,000	-98.00%	\$ 755,000	\$ 711,000	\$ (44,000)	-6%	Within the variance allowance	Within the variance allowance
205	2022	ESRI Application Health	Plant and Field	\$ 380,000	Level 3	\$0	-\$380,000	-100.00%	\$ 726,851	\$ 818,000	\$ 91,149	13%	Within the variance allowance	Within the variance allowance
217	2022	Fermi Enhancements	Plant and Field	\$ 500,000	Level 3	\$421,000	-\$79,000	-15.80%	\$ 500,000	\$ 421,000	\$ (79,000)	-16%	Within the variance allowance	Within the variance allowance
180	2022	Fuel Supply Application Health	Plant and Field	\$ 470,000	Level 3	\$387,000	-\$83,000	-17.66%	\$ 1,239,600	\$ 1,240,000	\$ 400	0%	Within the variance allowance	Within the variance allowance
219	2022	Integrated Information Resource (I2R) Replacement	Plant and Field	\$ 12,910,000	Level 3	\$12,825,000	-\$85,000	-0.66%	\$ 12,910,000	\$ 13,420,000	\$ 510,000	4%	Within the variance allowance	Within the variance allowance
212	2022	Meter Data Management (MDM) Consolidation	Plant and Field	\$ 13,590,000	Level 3	\$13,157,000	-\$433,000	-3.19%	\$ 13,590,000	\$ 11,720,000	\$ (1,870,000)	-14%	Within the variance allowance	Within the variance allowance
185	2022	Nuclear Generation Business Systems Replacement	Plant and Field	\$ 620,000	Level 3	\$508,000	-\$112,000	-18.06%	\$ 1,684,400	\$ 1,836,000	\$ 151,600	9%	Within the variance allowance	Within the variance allowance
223	2022	Plant & Field Document Repository	Plant and Field	\$ 3,320,000	Level 3	\$3,031,000	-\$289,000	-8.70%	\$ 3,820,000	\$ 4,426,000	\$ 606,000	16%	Within the variance allowance	Within the variance allowance
226	2022	Primavera Modernization	Plant and Field	\$ 430,000	Level 3	\$423,000	-\$7,000	-1.63%	\$ 430,000	\$ 419,000	\$ (11,000)	-3%	Within the variance allowance	Within the variance allowance
191	2022	Renewable Operations Application Health	Plant and Field	\$ 123,760	Level 3	\$115,000	-\$8,760	-7.08%	\$ 326,280	\$ 346,000	\$ 19,720	6%	Within the variance allowance	Within the variance allowance
197	2022	System for Fossil Generation for Coal and Gas	Plant and Field	\$ 400,000	Level 3	\$394,000	-\$6,000	-1.50%	\$ 1,055,000	\$ 1,151,000	\$ 96,000	9%	Within the variance allowance	Within the variance allowance
227	2022	Automating Database Event Log Monitoring	Information Technology for IT	\$ 418,000	Level 3	\$319,000	-\$99,000	-23.68%	\$ 418,000	\$ 336,000	\$ (82,000)	-20%	Within the variance allowance	Within the variance allowance
251	2022	Cloud Management (Service Now)	Information Technology for IT	\$ 750,000	Level 3	\$647,000	-\$103,000	-13.73%	\$ 750,000	\$ 582,000	\$ (168,000)	-22%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534 - Reduced vendor costs via successful negotiations
253	2022	DTE Private Cloud Infrastructure as a Service	Information Technology for IT	\$ 832,293	Level 3	\$442,000	-\$390,293	-46.89%	\$ 1,472,293	\$ 1,013,000	\$ (459,293)	-31%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534 - Reduced vendor costs via negotiations
234	2022	IT for IT Application Health	Information Technology for IT	\$ 2,000,000	Level 3	\$1,669,000	-\$331,000	-16.55%	\$ 17,457,000	\$ 19,682,000	\$ 2,225,000	13%	Within the variance allowance	Within the variance allowance
243	2022	IT for IT Tools	Information Technology for IT	\$ 400,000	Level 3	\$254,000	-\$146,000	-36.50%	\$ 400,000	\$ 367,000	\$ (33,000)	-8%	Within the variance allowance	Within the variance allowance
271	2022	Network Access Control	Information Technology for IT	\$ 350,000	Level 3	\$186,000	-\$164,000	-46.86%	\$ 2,397,000	\$ 718,000	\$ (1,679,000)	-70%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534
274	2022	Network Operations Center (NOC) Automation Project	Information Technology for IT	\$ 750,000	Level 3	\$738,000	-\$12,000	-1.60%	\$ 750,000	\$ 774,000	\$ 24,000	3%	Within the variance allowance	Within the variance allowance
275	2022	PBX (Private Branch Exchange) Replacement	Information Technology for IT	\$ 189,000	Level 3	\$185,000	-\$4,000	-2.12%	\$ 189,000	\$185,000	\$ (4,000)	-2%	Within the variance allowance	Within the variance allowance
279	2022	Threat Intel module	Information Technology for IT	\$ 600,000	Level 3	\$524,000	-\$76,000	-12.67%	\$ 1,040,925	\$ 567,000	\$ (473,925)	-46%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534 - Efficiency Gains
287	2022	Cyber Security Defense Center (CSDC) Growth and Lifecycle Management	Information Protection Security	\$ 300,000	Level 3	\$157,000	-\$143,000	-47.67%	\$ 791,200	\$ 846,000	\$ 54,800	7%	Within the variance allowance	Within the variance allowance
308	2022	Backup Environmental Growth	Infrastructure Operations	\$ 500,000	Level 3	\$201,000	-\$299,000	-59.80%	\$ 1,521,800	\$ 910,000	\$ (611,800)	-40%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534
298	2022	Collaboration Application Health	Infrastructure Operations	\$ 1,500,000	Level 3	\$705,000	-\$795,000	-53.00%	\$ 19,358,600	\$ 24,019,000	\$ 4,660,400	24%	Under recovery greater than 20%	Partial Disallowance in U-21297

352	2022	Command Center Stand Up	Infrastructure Operations	\$ 200,000	Level 3	\$12,000	-\$188,000	-94.00%	\$ 200,000	\$12,000	\$ (188,000)	-94%	Within the variance allowance	Within the variance allowance
344	2022	Data Center Modernization and Optimization	Infrastructure Operations	\$ 1,200,000	Level 3	\$1,084,000	-\$116,000	-9.67%	\$ 3,662,000	\$ 4,125,000	\$ 463,000	13%	Within the variance allowance	Within the variance allowance
353	2022	Digital Infrastructure and Services	Infrastructure Operations	\$ 8,310,002	Level 3	\$6,408,000	-\$1,902,002	-22.89%	\$ 8,310,002	\$ 6,408,000	\$ (1,902,002)	-23%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534
354	2023	Digital Infrastructure and Services	Infrastructure Operations	\$ 250,000	Level 3	\$0	-\$250,000	-100.00%	\$ -	\$ -	\$ -	-23%	Over Recovery greater than 20%	Provided in Witness Sharma's testimony for Instant case U-21534
326	2022	Endpoint End of Life Electric Support Services	Infrastructure Operations	\$ 800,000	Level 3	\$611,000	-\$189,000	-23.63%	\$ 2,196,800	\$ 2,437,000	\$ 240,200	11%	Within the variance allowance	Within the variance allowance
355	2022	Enterprise Monitoring Strategy Operational Growth	Infrastructure Operations	\$ 500,000	Level 3	\$448,000	-\$52,000	-10.40%	\$ 1,398,800	\$ 1,631,000	\$ 232,200	17%	Within the variance allowance	Within the variance allowance
338	2022	Network Data Center End of Life Project	Infrastructure Operations	\$ 525,443	Level 3	\$402,000	-\$123,443	-23.49%	\$ 1,422,243	\$ 1,830,000	\$ 407,757	29%	Under recovery greater than 20%	Partial Disallowance in U-21297
341	2022	Network End of Life Electric	Infrastructure Operations	\$ 771,015	Level 3	\$397,000	-\$374,015	-48.51%	\$ 1,917,215	\$ 1,985,000	\$ 67,785	4%	Within the variance allowance	Within the variance allowance
317	2022	Server Engineering Support Services	Infrastructure Operations	\$ 2,700,000	Level 3	-\$3,466,000	-\$6,166,000	-228.37%	\$ 7,398,600	\$ 9,634,000	\$ 2,235,400	30%	Under recovery greater than 20%	Partial Disallowance in U-21297
349	2022	Virtual Desktop Infrastructure	Infrastructure Operations	\$ 260,000	Level 3	\$258,000	-\$2,000	-0.77%	\$ 260,000	\$ 265,000	\$ 5,000	2%	Within the variance allowance	Within the variance allowance
350	2022	Wide Area Network Redesign Session Initiation Protocol Backhaul	Infrastructure Operations	\$ 828,000	Level 3	\$654,000	-\$174,000	-21.01%	\$ 828,000	\$ 782,000	\$ (46,000)	-6%	Within the variance allowance	Within the variance allowance

Michigan Public Service Commission
DTE Electric Company
Actual Capital Expenditures 8-Months Ending July 31, 2024
Nuclear Production Plant
(\$000)

Case No.: U-21534
Exhibit: A-47
Schedule: LL1
Witness: J.C. Davis
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	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Line No.	Description	Actual Dec 2023	Actual Jan 2024	Actual Feb 2024	Actual Mar 2024	Actual Apr 2024	Actual May 2024	Actual Jun 2024	Actual Jul 2024	Historical 8 mos. ended 7/31/2024
1	Nuclear Production Plant									
2	Routine and Small Projects 1/	9,546	3,723	5,308	13,301	15,085	9,548	5,955	21,103	83,570
3	Non-Routine and Large Projects 2/	12,956	9,468	2,111	13,671	15,228	18,739	17,072	(12,422)	76,823
4	Total Projects	22,502	13,191	7,419	26,972	30,313	28,287	23,027	8,681	160,393
5	Total Projects as projected in U-21534 Exhibit A-12, Schedule B5.3	24,313	18,137	19,087	19,827	34,830	12,373	19,593	14,614	162,774

1/ See Exhibit A-47, Schedule LL1, Pages 2 and 3

2/ See Exhibit A-47, Schedule LL1, Page 4

Michigan Public Service Commission
DTE Electric Company
Actual Capital Expenditures 8-Months Ending July 31, 2024
Nuclear Production Plant
Routine and Small Projects
(\$000)

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	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Line No.	Project Name	Actual Dec 2023	Actual Jan 2024	Actual Feb 2024	Actual Mar 2024	Actual Apr 2024	Actual May 2024	Actual Jun 2024	Actual Jul 2024
1	Routine and Small Projects								
2	Undervessel replacements	212	865	49	1,177	44	1,631	242	5,865
3	Visual Annunciator System (VAS) replacement	0	0	0	0	0	0	0	0
4	Security system computer	715	423	466	459	403	527	1,252	834
5	Plant radio system	567	362	342	74	72	634	455	283
6	Residual heat removal service water outlet valve (F068A/B) replacement	76	96	317	1,129	819	89	104	989
7	Environmentally Qualified (EQ) seal replacements	0	0	0	0	0	0	0	0
8	Safety relief valves (SRVs)	391	(812)	22	1,076	1,037	270	0	966
9	Snubbers	23	(14)	9	796	228	6	0	429
10	Low Pressure Turbine (LPT) expansion joints	0	0	0	0	0	0	0	0
11	Unitized actuators (UAs) replacement	507	195	373	699	593	1,328	234	1,310
12	Residual Heat Removal (RHR) motors replacement	117	532	285	1,005	644	131	31	717
13	High pressure stop and control valves (HPSV/HPCV) replacement	528	190	666	1,512	1,123	1,126	238	1,866
14	Reactor recirculation system (RRS) replacements	0	0	0	0	0	0	0	0
15	Main Steam Isolation Valves (MSIV) replacement	227	5	(1)	750	1,121	(101)	(6)	798
16	Low pressure stop and intercept valves (LPSV/LPIV) replacements	352	125	588	994	350	955	148	1,204
17	Valve replacements	146	(97)	190	210	1,536	825	(13)	1,409
18	Main steam bypass valve (MSBV) replacement	0	0	0	0	0	0	0	0
19	Core spray line vents	108	204	114	102	188	71	41	174
20	Diesel fire pump	0	0	0	0	0	0	0	0
21	Emergency equipment service water (EESW) pump	0	0	0	0	0	0	0	0
22	Motor operated valves (MOV)	0	0	0	0	0	0	0	0
23	Reactor Protection System (RPS) motor-generator (MG) set replacements	(385)	13	13	420	195	59	17	15
24	Emergency Diesel Generator (EDG) cylinder liner replacements	0	0	0	0	0	0	0	0
25	Flow accelerated corrosion (FAC) program piping insulation	73	1	195	278	1,011	8	2	640
26	Owner Controlled Area (OCA) security access control system	0	0	0	0	0	0	0	0
27	Residual heat removal service water (RHRSW) pump	0	0	0	0	0	0	0	0
28	Control rod drive mechanism (CRDM) replacement	56	12	25	142	635	(34)	15	311
29	Moisture separator reheater relief valve (MSRRV)	0	0	0	0	0	0	0	0

Michigan Public Service Commission
DTE Electric Company
Actual Capital Expenditures 8-Months Ending July 31, 2024
Nuclear Production Plant
Routine and Small Projects
(\$000)

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	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Line No.	Project Name	Actual Dec 2023	Actual Jan 2024	Actual Feb 2024	Actual Mar 2024	Actual Apr 2024	Actual May 2024	Actual Jun 2024	Actual Jul 2024
30	General plant tools	1,505	223	208	406	470	220	28	50
31	Heater Drains Pump (HDP) replacement	0	0	0	0	2	0	(2)	0
32	Condensate pump	205	6	184	250	79	(3)	1	192
33	Residual Heat Removal (RHR) HVAC hydramotors	0	0	0	0	0	0	69	30
34	Breaker replacement	0	0	0	0	0	0	0	0
35	Plant wireless	183	279	139	88	41	173	164	159
36	Condensate filter demineralizer (CFD) septas	1	0	180	50	1	0	4	155
37	Refuel bridge mast	0	0	0	0	0	0	0	0
38	Refuel Floor monorail replacement	(6)	20	22	41	10	14	227	22
39	Switchyard footer replacement	0	0	0	0	0	0	0	0
40	Unitized Actuator shop	8	6	6	4	56	14	8	8
41	Hot machine shop	947	456	388	313	2	288	142	140
42	Contractor time & work tracking system	0	0	0	0	0	0	0	0
43	Piping replacements	28	1	(26)	46	8	26	8	74
44	Security defensive strategy simulator	0	0	0	0	0	0	0	0
45	Control rod blade (CRB) replacements	1,495	31	(9)	0	0	0	0	0
46	Pump and motor replacements	0	44	3	57	672	14	7	302
47	Reverse osmosis system replacement	0	0	0	0	0	0	0	0
48	Independent Spent Fuel Storage Installation (ISFSI) casks	2	1	0	2	1,028	(5)	15	(4)
49	Integrated Plant Computer System (IPCS) replacement	0	0	0	0	0	0	0	0
50	Paperless recorders replacement	0	0	0	0	0	0	0	0
51	Roof replacements	568	33	0	(0)	0	0	0	0
52	Neutron Monitoring System replacements	22	17	32	16	10	24	2,060	130
53	SCRAM discharge header	320	347	233	347	(42)	437	338	119
54	Temporary power modifications	180	22	18	9	2	(25)	2	2
55	Balance of plant (BOP) battery replacement	85	32	18	212	558	14	0	315
56	Reactor feed pump turbine (RFPT) rotor	167	59	124	249	844	451	76	698
57	Hydrogen seal replacement	124	46	93	165	264	319	44	358
58	Heater Feed Pump (HFP) replacement	0	0	0	217	164	2	0	151
59	Natural draft cooling towers	0	0	42	4	915	56	2	391
60	Document management system enhancements	0	0	0	0	0	0	0	0
61	Remote monitoring	0	0	0	0	0	0	0	0
62	Electronic work package system	0	0	0	0	0	0	0	0
63	GSW Pump House Critical Digital Asset (CDA)	0	0	0	0	0	0	0	0
64	Balance of Projects (<\$500K)	0	0	0	0	0	0	0	0
65	Total Routine and Small Projects	9,546	3,723	5,308	13,301	15,085	9,548	5,955	21,103

Michigan Public Service Commission
DTE Electric Company
Actual Capital Expenditures 8-Months Ending July 31, 2024
Nuclear Production Plant
Non-Routine and Large Projects
(\$000)

Case No.: U-21534
Exhibit: A-47
Schedule: LL1
Witness: J.C. Davis
Page: 4 of 4

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
Line		Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
No.	Project Name	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	May 2024	Jun 2024	Jul 2024
1	Non-Routine and Large Projects								
2	Main Unit Generator replacement	3,300	5,849	(1,600)	5,408	1,358	10,698	4,938	1,794
3	Torus Vent Header	0	0	0	0	0	0	0	0
4	Underground safety-related service water piping	863	1,946	1,584	5,495	10,320	5,876	10,285	(17,429)
5	Main Unit Generator rotor replacement	0	0	0	0	0	0	0	0
6	Generator excitation automatic voltage regulator (AVR)	0	0	0	0	0	0	0	0
7	Transformer #65 and #69 replacements	0	0	0	36	105	3	1	1
8	License renewal implementation (LRI)	417	427	425	624	1,220	509	306	1,076
9	Circulating Water (CW) Discharge Pipe	0	0	0	0	0	0	0	0
10	Feed water heaters replacements	2,159	288	303	510	547	620	204	165
11	Drywell Coolers #12 and #13	0	0	0	0	0	0	0	0
12	Boraflex fuel storage racks	1,178	336	417	162	48	267	501	64
13	Radiation monitors	983	319	319	341	311	506	569	681
14	Reactor Building Freight Elevator	0	0	0	0	0	0	0	0
15	Transformer replacements	0	0	0	0	0	0	0	0
16	Drywell Cooler #8	0	0	0	0	0	0	0	0
17	Fire header restoration	204	(4)	(1)	0	0	0	0	0
18	Drywell Coolers #10 and #14	0	0	0	0	0	0	0	0
19	Off-gas chiller replacement	0	0	0	0	0	0	0	0
20	General Service Water (GSW) intake groin replacement	3,695	111	(20)	0	0	0	0	0
21	Turbine Building moisture barrier	36	53	180	22	230	29	137	131
22	Digital control modifications	0	0	0	0	0	0	0	0
23	Drywell moisture barrier replacement	66	83	420	988	970	62	2	964
24	Fire detection system replacement	13	38	59	56	80	57	62	78
25	Interruptable Air Supply (IAS) dryer replacements	4	10	7	10	20	69	58	47
26	Reactor recirculation motor-generator (RRMG) replacements	0	0	0	0	0	0	0	0
27	Turbine controls replacements	37	11	19	18	20	45	10	8
28	Sanitary system replacement	0	0	0	0	0	0	0	0
29	Emergency Diesel Generator Service Water (EDGSW) piping	0	0	0	0	0	0	0	0
30	Other Capital Spend <\$100K	0	0	0	0	0	0	0	0
31	Total Non-Routine and Large Projects	12,956	9,468	2,111	13,671	15,228	18,739	17,072	(12,422)

Michigan Public Service Commission
DTE Electric Company
Nuclear Fuel Expenditures
(\$000)

Case No.: U-21534
Exhibit: A-47
Schedule: LL2
Witness: J.C. Davis
Page: 1 of 1

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Line			Calendar Year	Calendar Year	Calendar Year	Calendar Year	Calendar Year	Calendar Year	Calendar Year	Calendar Year	Total Projected	Total Actual
No.	Rate Case	Description	2018	2019	2020	2021	2022	2023	2024	2025		
1	U-20162	Total Nuclear Fuel	74,257	77,706	129							
2	U-20561	Total Nuclear Fuel	72,428 ^A	83,463	147	114,411						
3	U-20836	Total Nuclear Fuel			278 ^A	122,703	200	111,014				
4	U-21297	Total Nuclear Fuel				120,112 ^A	3,246 ^A	117,421	240			
5	U-21534	Total Nuclear Fuel					3,246 ^A	110,008 ^A	2,000	135,077		
6	Actual	Total Nuclear Fuel	72,428	78,035	278	120,112	3,246	110,008				
7	U-20162	Total Nuclear Fuel (projected expenditures only)	74,257	77,706							151,963	150,463
8	U-20561	Total Nuclear Fuel (projected expenditures only)		83,463	147	114,411					198,022	198,425
9	U-20836	Total Nuclear Fuel (projected expenditures only)				122,703	200	111,014			233,917	233,366
10	U-21297	Total Nuclear Fuel (projected expenditures only)						117,421	240		117,661	112,008 ^B

Notes:
A: Amounts considered actual expenditures in applicable rate case
B: Includes 2024 projected amount of \$2.0 million

Michigan Public Service Commission
DTE Electric Company
Rebuttal Freeman Disallowance Residential and Business Charger Rebates

2024				TEP 2025								
Customer Segment	Customer Sub-Segments	Rebate	Approx. Count	TEP Customer Segment	Customer Sub-Segments	Rebate ⁴⁰	Approx. Count	Approx Amount	% of Total	Alloc \$8M biz, \$1M res	No of Rebates Reduced	
Single-Family Homes	All	\$500	3,400	Single-Family Homes	LI Level 2	\$2,200	1421	3,126,000	A	1,000,000	455	
	Low - Med Income	\$1,500	600									
Public L2s		\$2,000	1,046	Multi-Unit Dwellings	LI Level 2	\$14,400	59	849,600	B	5%	424,744	29
		\$2,000			Non-LI Level 2	\$5,000	565	2,825,000	B	18%	1,412,315	282
Public				Public	DAC/rural on-route DCFC	\$70,000	52	3,640,000	B	23%	1,819,761	26
		\$46,560	74		All other on-route DCFC	\$50,000	52	2,600,000	B	16%	1,299,829	26
Fleet				Fleet	Transit bus DCFC	\$70,000	8	560,000	B	3%	279,963	4
		\$25,000	82		School bus DCFC	\$70,000	23	1,610,000	B	10%	804,894	11
		\$2,500	118		Other DCFC	\$70,000	42	2,940,000	B	18%	1,469,807	21
					Level 2	\$2,500	391	977,500	B	6%	488,686	195
Total			5,320				2613	19,128,100	100%	9,000,000	1,050	

^[1] LI SFH and LI MUD are average estimates based on total installation costs and would not exceed actual costs

sum(B) 16,002,100

Michigan Public Service Commission
DTE Electric Company
Charging Forward Expansion Cost Projections
(\$000)

Case No.: U-21534
Exhibit: A-12
Schedule: B5.9
Witness: P. Bennett
Page: 1 of 1

Line No.	Description	(a)	(b)	(c)	(d)	(e)	(f)
		Historical 12 mos. ended 12/31/2022	Projected Bridge Period 12 mos. ending 12/31/2023	12 mos. ending 12/31/2024	Bridge Period 24 mos. ending 12/31/2024	Test Period 12 mos. ending 12/31/2025	
1	Projected Capital Expenditures						
2	Program Administration	15	223	171	394	-	
3	Business and eFleet Charger Rebates	-	155	4,264	4,419	-	
4	Home Charger Installation	-	520	-	520	-	
5	Business Charger Installation	-	-	1,274	1,274	-	
6	Charging Hubs	-	96	1,800	1,896	3,500	
7	eFleet Battery Support	-	-	5,000	5,000	-	
8	TEP IT Capabilities	-	-	-	-	1,600	
9	Total Capital Expenditures	\$ 15	\$ 994	\$ 12,509	\$ 13,503	\$ 5,100	
10	Projected O&M Expenditures						
11	Education & Outreach O&M	-	233	1,500	1,733	1,500	
12	Program Administration O&M	-	688	793	1,481	1,752	
13	Total O&M Expenditures	\$ -	\$ 922	\$ 2,293	\$ 3,214	\$ 3,252	
14	Projected Regulatory Asset Costs						
15	Program Administration	950	699	849	1,548	-	
16	Education & Outreach	1,216	802	300	1,102	-	
17	Residential Customer Rebates	655	1,828	2,000	3,827	3,126	A
18	Business and eFleet Charger Rebates	2,599	2,772	7,732	10,504	16,002	B
19	Business Charger Installations	-	-	2,041	2,041	-	
20	Additional Elements	564	-	-	-	-	
21	Emerging Tech Fund	-	825	1,000	1,825	1,000	
22	School Bus Chargers	-	-	2,000	2,000	-	
23	Total Regulatory Asset Costs	\$ 5,985	\$ 6,927	\$ 15,922	\$ 22,848	\$ 20,128	
24	Total Costs	\$ 6,000	\$ 8,842	\$ 30,724	\$ 39,566	\$ 28,480	

Actual Capital Expenditures 2019-2023 \$ thousands
Line

No.	Description	2019	2020	2021	2022	2023
		Actual	Actual	Actual	Actual	Actual
		1-Jan	Jan 1	Jan 1	Jan 1	Jan 1
		- December 31	- December 31	- December 31	- December 31	- December 31
1	Capital Expenditures					
2	Business and eFleet Charger Rebates	62	-	195	-	-
3	Number of Customers	1	-	1	-	-

MPSC Case No: U-21534

Requester: Evgo

Question No.: EVgoDE-1.1c

Respondent: P. Bennett

Page: 1 of 1

Question: In the Commission's Final Order in Docket No. U-21297, the Commission approved the continuation and expansion of DTE's Business Charger Rebate program and approved DTE's funding request for that program.

Please provide:

c. The number of sites and stalls that are in the pipeline to receive funding through the Business Charger Rebates program.

Answer: The number of sites (which is the same as the number of Applications) and stalls (electrified parking spaces) that are in the pipeline to receive funding through DTE Electric's Business Charger Rebates program are 149 and 593, respectively.

Attachment: *None*

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-4.149c.

Respondent: P. Bennett

Page: 1 of 1

Question: 149. Refer to Table 11 on page 55 of Ms. Bennett's direct testimony on the EV/TEP CBA assumed tariff rates. Please: c. Provide the percent split between on-peak and off-peak usage. Explain why this split would not change as more EVs are used throughout the day and for longer trips during the day, during peak demand periods.

Answer: The TEP BCA did not include calculations accounting for a split between on-peak and off-peak usage. However, per historical data through April 2024, residential DTE Electric customers on the EV-specific rate (D1.9) and customers participating in the Home Charger Rebates pilot, had loads that were approximately 92% off-peak. These are residential customers who received a rebate when the program had a networked charger requirement, and had to be on D1.9, D1.2 or D1.8 rate. The data for these chargers, comes directly from the charger. This split is unlikely to change significantly in the foreseeable future with more EVs during the TEP years due to the relative nascency of EVs, the tendency of EV owners to charge off-peak, and the influence of smart charging technology and time-of-use pricing.

Attachment: *None*

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-3.92b

Respondent: B. Hill

Page: 1 of 1

Question: 92. Refer to lines 15-25 on page 28 and lines 1-6 on page 29 of Mr. Hill's direct testimony on incremental charging infrastructure for EVs. Please:
b. Explain why the Company is requesting incremental capital spending in this area when auto manufactures are reducing their plans to build fully rechargeable EVs due to limited customer demand and are redirecting their manufacturing to self-charging hybrid vehicles.

Answer: Despite temporary reductions by some auto companies, the dynamic EV market persists. DTEE recorded its highest-ever EV count in its service area in April 2024, with a year-to-date increase exceeding 33% compared to the prior year. The forecast for EV adoption in the US, including Michigan, aligns with historical trends and external projections of EV adoption. The Company believes that Michigan, as a hub for automotive innovation, should strategically position itself for this future.

Attachment: None

Co-Respondent(s): P. Bennett

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-4.142a.

Respondent: P. Bennett

Page: 1 of 1

Question: 142. Refer to page 23 of Ms. Bennett's direct testimony on the future sales of EVs in the Company's service area. In the last few months, it has become clear that demand for EVs has declined as consumers have become leery of purchasing EVs for a variety of reasons and manufacturers, such as Ford and General Motors, have redirected their manufacturing to self-charging hybrid vehicles, which appear to have gained more acceptance from consumers. Given this major paradigm change, has the Company: a. Reflected the lower demand in its projections of EV sales and penetration in its service area in its forecasts in this rate case versus Case No. U-21297? If yes, show how. If no, explain why not.

Answer: Please refer to response with question AGDE-3.92b. In Q2, EVs comprised 8% of all new-vehicle sales which surpasses the previous record of 7.2% set a year earlier.

The Company regularly monitors changes in the EV market and adjusts forecasts accordingly. Please see the table below showing the EV forecast in this instant case compared to U-21297. As seen below, the forecast is lower in 2024, 2025, and 2026. Additionally, the Company does not view a few months of market dynamics to be considered a paradigm shift in an emerging market.

Cumulative Vehicles	2024	2025	2026	2027	2028
U-21297	79,870	115,680	160,563	216,102	285,741
U-21534	64,762	98,167	153,854	232,201	325,134

Attachment: None

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-4.142b.

Respondent: P. Bennett

Page: 1 of 1

Question: 142. Refer to page 23 of Ms. Bennett's direct testimony on the future sales of EVs in the Company's service area. In the last few months, it has become clear that demand for EVs has declined as consumers have become leery of purchasing EVs for a variety of reasons and manufacturers, such as Ford and General Motors, have redirected their manufacturing to self-charging hybrid vehicles, which appear to have gained more acceptance from consumers. Given this major paradigm change, has the Company: b. Adjusted its capital spending downward on the EV/TEP programs in this rate case? If yes, show how. If no, explain why not.

Answer: See Response to AGDE-4.142a with respect to the Company's view of EV adoption. Beginning in 2025, the first year of expenditure for the transportation electrification plan, the Company has proposed to not waive Contribution In Aid of Construction (CIAC) beyond revenue credits from the existing line extension policy. Consequently, the Company has ceased to include capital spending recovery on EV/TEP programs associated with business charging infrastructure enablement projects. For 2025, the only requested capital expenditures are \$3.5 million for Charging Hubs that were approved in Case No. U-20836 and \$1.6 million for the development of TEP IT capabilities.

Attachment: None

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-4.142c.

Respondent: P. Bennett

Page: 1 of 1

Question: 142. Refer to page 23 of Ms. Bennett's direct testimony on the future sales of EVs in the Company's service area. In the last few months, it has become clear that demand for EVs has declined as consumers have become leery of purchasing EVs for a variety of reasons and manufacturers, such as Ford and General Motors, have redirected their manufacturing to self-charging hybrid vehicles, which appear to have gained more acceptance from consumers. Given this major paradigm change, has the Company: c. Considered pausing or refraining the increased spending on various programs until the interest for EVs resumes? If yes, explain how and when. If no, why not?

Answer: Please refer to response AGDE-3.92b and response AGDE-4.142a with respect to the Company's view of EV adoption. Also, the Company has designed the strategy to be able to adapt to these EV market dynamics, while maintaining a cautious approach to EV-related programs. As stated in my direct testimony (page PB-50, rows 4-15), DTE Electric has requested flexibility to adjust TEP programming in line with EV adoption trends, within approved investment limits, and while maintaining affordability at the portfolio level. This means program spending will be adjusted within customer segments based on customer demand.

Attachment: None

Michigan Public Service Commission
DTE Electric Company
Discovery Response MSNCDE-5.5a(S1)

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-5.5a (S1)

Respondent: S. Deol

Page: 1 of 2

Question: 5. Refer to U-21534 Testimony - Part 1 S. S. DEOL Page SSD-52, line 15 which states “This rebuilt and redesigned subtransmission system will support area load growth for existing and new customers, and with updated technology will provide the ability to support DER interconnections, including large-scale solar arrays.”

a. Provide any and all load forecasts, capacity ratings, and other information which shows that the Company’s subtransmission capacity planning criteria would be overloaded by December 31, 2028. Identify the capacity planning criteria violation and estimate the number of hours a year the criteria violation is expected to exist in 2028.

Answer: DTE Electric objects to the request for the reasons that the request is overly broad, seeks excessive detail, seeks confidential, proprietary research, or commercial information belonging to DTE Electric, the disclosure of which would cause DTE Electric and its customers competitive or commercial harm, seeks information involving Cyber Security, CEII (either critical energy infrastructure information or critical electric infrastructure information), North American Electric Reliability Corporation (NERC) NERC-CIP (including but not limited to BES Cyber Asset information subject to protection under the Information Protection Program pursuant to NERC Reliability Standards CIP003-6 and CIP-011-2), Supervisory Control and Data Acquisition (SCADA), confidential Midcontinent Independent System Operation (MISO) and ITC Holdings Corp and/or its affiliate companies’ information in the possession of DTE Electric, U.S. export control laws and regulations, including but not limited to 10 C.F.R. Part 810 et. seq., or 10 CFR Part 2.390. In addition, the information requested constitutes specific engineering, vulnerability, or detailed design information about proposed or existing critical infrastructure that relates details about the production, generation, transportation, transmission, or distribution of energy that could be useful to a person in planning an attack on critical infrastructure.

Subject to these objections, and without waiving these objections, DTE Electric would answer as follows:

Michigan Public Service Commission
DTE Electric Company
Discovery Response MSNCDE-5.5a(S1)

Case No.: U-21534

Exhibit: A-50

Schedule: OO1

Witness: S. Deol

Page: 2 of 2

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-5.5a (S1)

Respondent: S. Deol

Page: 2 of 2

Please see attachment labelled "NDA CEII U-21534 MNSCDE-5.5a(S1) – Subtransmission Load Data".

Attachment: NDA CEII U-21534 MNSCDE-5.5a(S1) – Subtransmission Load Data

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-8.5a

Respondent: J. Kryscynski

Page: 1 of 2

- Question:** 5. Refer to Mr. Kryscynski's testimony at page 56, which states "The engineering team evaluates alternatives to meet the system needs and selects the best project or program to move forward. If necessary, a BCA takes place as part of the engineering process to select the best option. The solution which is selected to move forward is scored in the GPM for prioritization." Refer also to NDA U-21534 MNSCDE-1.8a GPM CONFIDENTIAL, which provides GPM scores for 138 different projects in tab "GPM Results".
- a. Provide every benefit-cost analyses completed on any of these particular 138 projects. Please also provide any alternatives to these 138 projects that were considered.

Answer: The Company has performed two benefit-cost analyses, one for PTMM and one for strategic undergrounding, which were provided in MNSC3.10b.

The Company has also provided a provided a prioritization model for Distribution Automation in MNSCDE-12.13 which is not a cost-benefit model but does use costs and benefits as a part of prioritization.

A summary of alternatives considered for many of 138 programs and projects listed in the GPM are provided in the attachment MNSCDE-8.5a Project Alternatives.

While some projects may not have specific alternatives listed in this attachment, alternatives were likely considered during the early phases of the engineering process. During initial planning stages of large projects, multiple design options are often explored as different engineering groups collaborate to brainstorm high-level solutions. An initial set of solutions will be narrowed down if some solutions are determined to be unsuitable for reasons such as, but not limited to, the following:

- Does not adhere to DTE engineering standards and practices
- Availability or lead time of equipment is too long
- An extended outage duration is required to complete project
- Alternative is overly complex and not markedly better than other options

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-8.5a

Respondent: J. Kryscynski

Page: 2 of 2

In the early stages of project development, alternatives are often not documented because of the high number of proposed solutions and the ability to dismiss some alternatives without significant engineering analysis. Initial engineering investigations narrow down the high number of proposed alternatives to a select few or sometimes single project scope to be further reviewed.

Even if no suitable alternative solution is developed, the proposed solution is reviewed by subject matter experts to confirm that the solution is the best engineering solution to the problem and a reasonable and prudent use of capital funds.

Attachment: U-21534 MNSCDE-8.5a-01 Project Alternatives

Michigan Public Service Commission
DTE Electric Company
Discovery Response MNSCDE-8.5a

U-21534 MNSCDE-8.5a-01 Project Alternatives

GPM Results - Ranked and Sorted

GPM Ranking	GPM Project ID	Project/Program Name	A12 Tab	Alternatives
1	2005	ADMS: DMS/OMS	A-12 B5.4 Tech	
2	2008	Pole and Pole Top Maintenance and Modernization (PTMM)	A-12 B5.4 Resilience	
3	2007	Frequent Outage Program (CEMI)	A-12 B5.4 Resilience	
4	20201014	Subtransmission Redesign & Rebuild: Tie 1568	A-12 B5.4 Redesign	1. Increase amount of load blocked: Adjust setting at CROWN substation.
5	1015	40 kV: Automatic Pole Top Switch	A-12 B5.4 Resilience	
6	20201053	4.8 kV CC: Hawthorne Relief and Circuit Conversion	A-12 B5.4 Redesign	
7	2001	4.8 kV Hardening	A-12 B5.4 Resilience	
8	20191015	CODI: Charlotte Network Upgrade	A-12 B5.4 Redesign	1. Eliminate AC Network and convert to radial system 2. Rebuild existing system at 4.8kV with direct replacements
9	2017	Distribution Automation	A-12 B5.4 Tech	
10	20191069	Subtransmission Redesign & Rebuild: Trunk 2237-ST	A-12 B5.4 Redesign	
11	20191016	CODI: Garfield Network Upgrade	A-12 B5.4 Redesign	1. Converting to a below grade vault-based system was investigated at the start of the CODI initiative. Peer utility visits were conducted, and analysis was completed comparing cost, operability, and impact on the project schedule
12	20230023	Subtransmission Redesign & Rebuild: Trunk 7105	Planned for IRM	
13	20191042	Substation Risk: Savage	A-12 B5.4 Resilience	1. Build a new substation which was not adopted as footprint was not available.
14	20191067	Subtransmission Redesign & Rebuild: Trunk 7106	A-12 B5.4 Redesign	1. Parallel existing cables with new cables 2. Replace existing cables for only a segment of the line
15	2029	4.8 kV CC: ISO Conversion Program	A-12 B5.4 Redesign	
16	20230006	4.8 kV CC: Zenon Circuit Conversion Phase 2	A-12 B5.4 Redesign	
17	20201046	Subtransmission Redesign & Rebuild: Trunk 2419	Planned for IRM	
18	20191019	CODI: Howard Conversion	A-12 B5.4 Redesign	1. Eliminate AC Network and convert to radial system. 2. Rebuild existing system at 4.8kV with direct replacements
19	20191034	4.8 kV CC: McKinstry Sub Decommission	A-12 B5.4 Redesign	
20	20191005	Substation Risk: Port Huron	A-12 B5.4 Resilience	1. Transfer all load from PTHUR to Surrounding Substations. 2. Install Switchgear/Reclosers Outside 3. Install new Breakers in Basement of Building 4. Decommission PTHUR and Build a new 13.2kV Substation at a new site 5. Install 9 position indoor switchgear and maintain existing circuit configurations
21	20191082	8.3 kV CC: Pontiac Overhead/Underground Conversion	A-12 B5.4 Redesign	1. Replace / update 8.3kV substation equipment which was not adopted as voltage class is not compatible with DTE inventory.
22	20191025	4.8 kV CC: Grosse Pointe Substation and Circuit Conversion	Planned for IRM	
23	20191065	Subtransmission Redesign & Rebuild: Trunk 2255	A-12 B5.4 Redesign	
24	20230020	4.8kV CC: Barber Substation and Circuit Conversion	Planned for IRM	1. Property close to existing BUNRT substation was considered, however properties environmental and survey results proved this site less than ideal
25	20231006	Subtransmission Redesign & Rebuild - Trunk 2448	Planned for IRM	
26	2035	CODI: Targeted Network Secondary Cable Replacement	A-12 B5.4 Redesign	
27	20191012	4.8 kV CC: I-94 Substation and Circuit Conversion (Promenade)	A-12 B5.4 Redesign	
28	20191079	Substation Risk: Chestnut	A-12 B5.4 Resilience	
29	2003	Cable Replacement Program	A-12 B5.4 Resilience	
30	20231004	Subtransmission Redesign & Rebuild: Trunk 1444	Planned for IRM	
31	20191023	CODI: Islandview Substation	A-12 B5.4 Redesign	
32	20230052	Subtransmission Redesign & Rebuild: Tie 3416 Reconductoring	Planned for IRM	
33	20201026	Subtransmission Redesign & Rebuild: Bernard	Planned for IRM	1. Reconductor all of tie 3220 to correct voltage issues. This would be a significantly greater scope and cost.
34	20191017	CODI: Kent/Gibson Conversion	A-12 B5.4 Redesign	
35	20230027	Subtransmission Redesign & Rebuild: Trunk 7386	Planned for IRM	
36	2004	URD Replacement Program	A-12 B5.4 Resilience	
37	20191066	Subtransmission Redesign & Rebuild: Trunk 7333	A-12 B5.4 Redesign	1. Replace existing cable of 7333T line.
38	20191014	CODI: Alfred Substation Expansion	A-12 B5.4 Redesign	1. Build a new 13.2kV substation and transfer load from Midtown
39	20201012	Subtransmission Redesign & Rebuild: Trunk 4217	A-12 B5.4 Redesign	1. Parallel existing cable with new cable
40	20191037	4.8 kV CC: Birmingham Decommissioning and Circuit Conversion	A-12 B5.4 Redesign	
41	20201007	Subtransmission Redesign & Rebuild: Trunk 2455	Planned for IRM	1. Replacing underground cable with overhead cables 2. Reroute cables around conduit crossing at M-10/8-mile
42	20230029	Subtransmission Redesign & Rebuild: Hurst	Planned for IRM	
43	20230005	4.8 kV CC: Cortland / Oakman / Linwood Consolidation	A-12 B5.4 Redesign	1. Like for like replacement of aging infrastructure at 4.8kV & 24kV (rejected due to benefits of consolidation)
44	20191070	Subtransmission Redesign & Rebuild: Tie 6907	Planned for IRM	1. Relocate portions of circuit to underground 2. Decommission TRK 6941 and reroute as TIE 6907
45	20230042	Subtransmission Redesign & Rebuild: Cortland Station Expansion	A-12 B5.4 Redesign	
46	2002	Breaker Replacement Program	A-12 B5.4 Resilience	
47	20230011	Substation Risk: McGraw	A-12 B5.4 Resilience	1. Change source side of station from 40kV to 120kV 2. Convert distribution side to 13.2kV 3. Construct new 120/13.2kV substation

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48	20201054 4.8 kV CC: Belleville Substation and Circuit Conversion	Planned for IRM	1. Construct class T substation on existing property 2. Construct Class A substation on existing property
49	20191062 Subtransmission Redesign & Rebuild: Sandusky Transformer 101 Breaker	A-12 B5.4 Redesign	1. Add section breaker to reduce outage window
50	20230033 Subtransmission Redesign & Rebuild: Waterman	Planned for IRM	
51	20191044 4.8 kV CC: Buckler Circuit Conversion	A-12 B5.4 Redesign	1. Keeping ARG0 Substation and the circuits at 4.8kV
52	20230004 4.8 kV CC: MAUME 8241 Downtown Clawson Conversion	A-12 B5.4 Redesign	
53	20201050 Subtransmission Redesign & Rebuild: Trunk 3546	Planned for IRM	
54	20201011 Subtransmission Redesign & Rebuild: Trunk 3509	A-12 B5.4 Redesign	1. Replace section of TRK 3509 cable
55	20230026 Subtransmission Redesign & Rebuild: Oak Beach Capacitor	A-12 B5.4 Redesign	
56	20230019 4.8kV CC: Yale-Slater Decommissioning and Circuit Conversion	Planned for IRM	1. Upgrade existing YALE and SLATR substations 2. Installing an STDF substation at YALE
57	20241001 Substation Risk: Savage Switchgear Replacement	A-12 B5.4 Resilience	1. Construct new substation
58	20191024 4.8 kV CC: Royal Oak Substation and Circuit Conversion	Planned for IRM	
59	20230049 Station Upgrade: Navarre	A-12 B5.4 Resilience	
60	20191029 Substation Risk: Apache	A-12 B5.4 Resilience	1. Construct new substation
61	20230062 Station Upgrade: Warren (Relay Replacement)	A-12 B5.4 Resilience	
62	20191058 Subtransmission Redesign & Rebuild: Boyne	A-12 B5.4 Redesign	1. Non wire alternative – New 5MW Solar or Battery generation at Selfridge 2. Reconductor TRK 7909 only
63	20230013 4.8kV CC: Hemlock Decommissioning and Circuit Conversion	A-12 B5.4 Redesign	1. Decomission neighboring substations - SPRUC, and PDMNT. 2. Acquire property between HEMLK and JAKSN for new substation
64	20230054 4.8 kV CC: Hilton Substation and Circuit Conversion	A-12 B5.4 Redesign	
65	20201013 Subtransmission Redesign & Rebuild: Trunk 2308	A-12 B5.4 Redesign	1. Adjust blocking setting at Benson Substation resulting in more load shed. 1. Replace Switchgear, rejected due to increased cost and goal to convert area to 13.2kV. 2. Replace TRF #1 with 13.2kV transformer and convert portions of 4.8kV circuits to 13.2kV
66	20230016 Substation Risk: Belleville Switchgear Decommission	A-12 B5.4 Resilience	
67	20230037 Subtransmission Redesign & Rebuild: 40kV Capacitor Banks at Armada and Adair	A-12 B5.4 Redesign	
68	20201064 4.8kV CC: Rochester Decommissioning and Tienken Relief	Planned for IRM	
69	20191039 System Loading: Jewell	A-12 B5.4 Redesign	1. Load transfers to Washington substation 2. Not enough capacity to utilize spare positions at Jewell substation. 3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
70	20230028 Subtransmission Redesign & Rebuild: Tie 3705	Planned for IRM	
71	20230007 4.8kV CC: SCOTN	A-12 B5.4 Redesign	1. EPPM to replace all (36) breakers at SCOTN substation with no circuit level work
72	20201021 4.8 kV CC: Calla Circuit Conversion and Phase 2	A-12 B5.4 Redesign	1. Pole top maintenance and/or line clearance
73	20201015 Subtransmission Redesign & Rebuild: Tie 6602	Planned for IRM	
74	20241002 Substation Risk: Seville	A-12 B5.4 Resilience	1. Do nothing. Rejected since the circuits are in an abnormal configuration putting increased risk on other circuits/substations.
75	20191068 Subtransmission Redesign & Rebuild: Trunk 4245	A-12 B5.4 Redesign	1. Alternative routes were considered that would result in more cable and conduit 1. Only replace the two sections("D" & "G") of cable which are over emergency ratings 2. Installing 650 EPR for all cable replacements
76	20201016 Subtransmission Redesign & Rebuild: Trunk 4266	A-12 B5.4 Redesign	
77	20201060 System Loading: Macomb/Golf	A-12 B5.4 Redesign	1. MEDNA New Split Double Bus Class A Sub conversion 2. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
78	20191074 CODI: Corktown Substation	A-12 B5.4 Redesign	
79	20201004 Subtransmission Redesign & Rebuild: Badax Transformer 102 Addition	A-12 B5.4 Redesign	
80	20230050 Station Upgrade: Northeast (Relay Replacement)	A-12 B5.4 Resilience	
81	20231001 Substation Risk: Hood	A-12 B5.4 Resilience	1. Construct new substation
82	20201001 System Loading: Globe	A-12 B5.4 Redesign	1. Build new STDF substation at Globe 2. Replace 2.5 MVA Transformer with 7.5MVA Transformer (New Class T Sub) 3. Install a Skid-mount Substation or Class R at the recent acquired property 4. Evaluated Non Wire Alternative (NWA) options either thru EWR or install a battery unit.
83	20201024 System Loading: Richmond/Armada	A-12 B5.4 Redesign	1. Install a new class A substation at new GRAMER station site 2. Richmond substation upgrade project is not a potential NWA candidate 3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
84	20201006 Subtransmission Redesign & Rebuild: Derby	Planned for IRM	1. Reconductor all of TIE 9107, Tie 9111, and Tie 9123.
85	20201018 Subtransmission Redesign & Rebuild: Trunk 4911	A-12 B5.4 Redesign	1. Reconductor all of Trunk 4911 2. Construct new 40kV trunk line from Boyne station to feed Chesterfield Transformer 3 and Cotton Transformer 1
86	20191077 System Loading: Diamond	A-12 B5.4 Redesign	1. Load transfers to neighboring areas 2. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
87	20241009 System Loading: Kings Point	A-12 B5.4 Redesign	1. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
88	20191063 Subtransmission Redesign & Rebuild: Custer Republic	A-12 B5.4 Redesign	
89	2021 Subtransmission Redesign & Rebuild: Thumb Electric Fault Isolation	Planned for IRM	
90	20191001 System Loading: Port Sanilac	A-12 B5.4 Redesign	1. Build new substation at existing PTSAN property, converting everything from 4.8kV to 13.2kV 2. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
91	20191045 System Loading: Carleton	A-12 B5.4 Redesign	

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DTE Electric Company
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91	20191045 System Loading: Carleton	A-12 B5.4 Redesign	1. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
92	20201027 Subtransmission Breaker Short Circuit Violations	A-12 B5.4 Redesign	
93	20241011 4.8 kV CC: Unionville DC 301 B1 Conversion	A-12 B5.4 Redesign	1. Convert Downstream of B4 Fuse 2. Reconductor ~6.1 Miles of OH 3. Feed Complaining Customers from Quail 312
94	20230012 4.8kV CC: Pittsfield Substation and Circuit Conversion	Planned for IRM	1. Crown Substation Transformer Replacement and PDC Replacement. 2. Purchase New Substation property between Wolverine and Crown Substations.
95	20191075 4.8 kV CC: Almont Relief and Circuit Conversion (Midas)	A-12 B5.4 Redesign	1. Build MIDAS as Class A Substaion 2. Feed MIDAS with 40kV - 120kV feed chosen due to close proximity of transmission lines (approx. ¼ MI) and improved reliability 3. Skidmounted Substation - Costly to expand to Class A substation if needed in the future
96	20201057 System Loading: Grenada	A-12 B5.4 Redesign	1. A 120-13.2kV substation scope was analyzed with ITC 2. The scope for a 40kV Class 'B' substation was also analyzed and will be revisited in the future at time of third transformer installation. 3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
97	20231016 System Loading: New Baltimore/Chesterfield	A-12 B5.4 Redesign	1. Installing third TRF at NBALT 13.2 but limited space. 2. Moving all NBALT load to JACOB 3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
98	20230014 System Loading: Tahoe	A-12 B5.4 Redesign	1. Use capacity at Wixom after upgrade to transfer load off of TAHOE 2. Multiple Reconfigurion alternatives for TRK 5906 at the intersection of 10 mile and Novi Road 3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
99	20191080 System Loading: Lark/Spruce	A-12 B5.4 Redesign	1. Building a new substation in an alternate location on new property and installing a third transformer at SPRUC. 2. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
100	20201058 4.8 kV CC: Unionville Decommissioning and Circuit Conversion	Planned for IRM	1. Upgrade UNVIL substation was considered but choosing to relocate at Randolph Station allowed us to take load off FGROV as well
101	20241003 Substation Risk: Imlay	A-12 B5.4 Resilience	
102	20201063 System Loading: Disco	A-12 B5.4 Redesign	1. Building 3 new distribution circuits on BRONC and upgrading DISCO XFMR 1 2. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
103	20191036 System Loading: Wixom	A-12 B5.4 Redesign	1. Construct New substation 2. Utilize TAHOE Substation 3. Use HANCK and/or WALLK substations 4. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
104	20191057 Subtransmission Redesign & Rebuild: Tie 7504	A-12 B5.4 Redesign	1. Alternate routes were not found to be advantageous
105	20191055 Subtransmission Redesign & Rebuild: Tie 810	A-12 B5.4 Redesign	1. Reconductor or replace all non-standard specified conductor/cable with standard specified 636AL OH conductor and 650 EPR UG cable. 2. New 345kV / 40 kV Station Split tie 810 into three separate tie lines. 3. New 120kV / 13.2kV Substation
106	20191056 Subtransmission Redesign & Rebuild: Tie 4105	A-12 B5.4 Redesign	1. Build a class B station (switching station) next to CROSW or APLGT and split TIE4105 into 2 tie lines. 2. Reconfigure TIE4105 3. Alternative routes have been considered for rebuilding the different sections of TIE4105 in the case we are not able to obtain easements or ROW for the routes proposed.
107	20201035 Subtransmission Redesign & Rebuild: Slocum	A-12 B5.4 Redesign	
108	20230024 Subtransmission Redesign & Rebuild: Tie 5208	Planned for IRM	
109	20191041 System Loading: Goodison	A-12 B5.4 Redesign	1. Using DTE Gas property -- DTE gas property is limited due to gas lines going through ITC corridor. 2. Build new ITC station and DTE substation from 345KV to 120kV to 13.2kV 3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
110	20230053 4.8 kV CC: GRFIN & WMSTN Conversions	A-12 B5.4 Redesign	1. Building underneath existing subtransmission lines 2. Build new STDF at GRFIN substation or on new property.
111	20191040 4.8 kV CC: White Lake Decommissioning and Circuit Conversion	A-12 B5.4 Redesign	
112	20230048 Station Upgrade: Lincoln	A-12 B5.4 Resilience	
113	20191059 Subtransmission Redesign & Rebuild: Tie 4104	A-12 B5.4 Redesign	1. Two alternative line routes were evalauted.
114	20230021 4.8 kV CC: Pinegrove Substation Relocation and Conversion	A-12 B5.4 Redesign	
115	20191038 System Loading: Sterling	A-12 B5.4 Redesign	1. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
116	20191004 System Loading: Brown City	A-12 B5.4 Redesign	1. 120-13.2kV Class T at BENET 2. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
117	20191013 CODI: Midtown Substation Expansion	A-12 B5.4 Redesign	1. Build a new 13.2kV substation and transfer load from Midtown 2. This project was considered for higher voltage distribution pilot substation. 3. Peaker Sites in the area for property usage of new substation were evaluated.
118	20201003 System Loading: Mayville	A-12 B5.4 Redesign	3. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
119	20191008 4.8 kV CC: Lapeer - Elba Expansion and Circuit Conversion (Apollo)	A-12 B5.4 Redesign	1. Feed new Apollo substation with 40kV instead of 120kV 2. Upgrade Fawn Class "R" substation to Class "A" instead of build new Apollo substation
120	20230025 Subtransmission Redesign & Rebuild: Trunk 4601	Planned for IRM	
121	20201062 System Loading: Otsego/Capac/Shaw	A-12 B5.4 Redesign	1. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
122	20191028 CODI: CATO Substation Expansion	A-12 B5.4 Redesign	1. Architecturally expand Cato substation into the parking lot to accomodate the third 120kV feed/circuit switcher proposed by ITC 2. Convert Cato 4.8kV in Project 1 to nearby 13.2kV circuits to avoid additional cable cutover/conversions in Project 4

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123	20201034	Subtransmission Redesign & Rebuild: Pigeon Area Improvement	Planned for IRM	1. Multiple powerflow analysis were competed using PSSE and TARA to study a wide spread area and propose the most beneficial solution for the system.
124	20191030	System Loading: Cody	A-12 B5.4 Redesign	1. Use neighboring substations TAHOE & NITRO to reduce loading on CODY
125	20201040	Subtransmission Redesign & Rebuild: Tie 3205	A-12 B5.4 Redesign	2. NWA considered while using neighboring substation to decrease loading on CODY
126	20201032	Subtransmission Redesign & Rebuild: STPS6	Planned for IRM	
127	20201002	4.8 kV CC: Quincy Conversion	A-12 B5.4 Redesign	1. Replace with 4.8 kV transformer within the existing fence 2. Install 3-833 kVA 4.8 kV overhead STDF 3. Replace with 13.2 kV 5 MVA or 7.5 MVA STDF at existing site and install 4 ISO's 4. Install 13.2 kV skid mount STDF closer to Kilgore to reduce/eliminate the 40kV tap distance 5. Evaluated against a traditional class T substation
128	20201065	System Loading: Spokane/Seneca	A-12 B5.4 Redesign	1. Evaluated for Non Wire Alternatives, was determined not to be a candidate.
129	20201022	Ann Arbor System Improvements	A-12 B5.4 Redesign	1. Keeping ARGO Substation and the circuits at 4.8kV was not considered due to the new customer load growth in the area and inability to support load growth at 4.8kV.
130	20230045	4.8 kV CC: Ann Arbor AC Network Conversion	Planned for IRM	1. Removal of the AC Network System in downtown Ann Arbor and conversion to traditional URD construction.
131	20230047	4.8 kV CC: Power line Conversion of MADSN 175L-W	A-12 B5.4 Redesign	
132	20230044	Substation Risk: Voyager	A-12 B5.4 Resilience	1. Considered having both underground and OH work completed consecutively.
133	20230043	Subtransmission Redesign & Rebuild: Maxwell Amherst	A-12 B5.4 Redesign	
134	20230036	Subtransmission Redesign & Rebuild: Small Projects & Reserve	A-12 B5.4 Redesign	
135	20230031	Subtransmission Redesign & Rebuild: Tempest Phase II	Planned for IRM	
136	20230030	Subtransmission Redesign & Rebuild: Praxair	A-12 B5.4 Redesign	1. ITC to install in-and-out (normally-closed breakers) 2. DTE to install main-tie-main configuration with a normally-open section breakers and line breakers 3. Customer to install automatic throw-over at Praxair distribution level
137	20230008	4.8 kV CC: Crestwood Substation	A-12 B5.4 Redesign	
138	20201030	Subtransmission Redesign & Rebuild: Mohican	Planned for IRM	

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-15.34b

Respondent: M. Elliott Andahazy

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Question: 34. Refer to the Company's response to MNSCDE-8.13a, which states "The 4.8kV Conversion and 4.8kV Hardening Programs are tracked separately and there is no overlap between the programs. The Company does not perform 4.8kV Hardening on circuits identified as likely to be converted in the near-term."

b. Explain how the Company "tracks" the 4.8kV hardening program spending. Provide any reports or analyses comparing the miles of 4.8kV circuits the Company expected to convert for the program dollars budgeted to the actual cost per circuit mile hardened.

Answer: The Company objects for the reasons that the information requested consists of confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which is contrary to contractual rights of third parties and/or would cause the Company, its ratepayers, and its customers competitive harm. Without waiving these objections, but subject to them, the Company responds as follows:

The Company tracks program spending using its financial systems. The Company tracks 4.8kV Hardening Program investments and miles completed in total at the program level.

Attachment: NDA U-21534 MNSCDE-15.34b-01 4.8kV Hardening Program Cost per Mile Analysis

Co-Respondent: Legal

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-15.37

Respondent: M. Elliott Andahazy

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Question: 37. Refer to the Company's response to MNSCDE-8.16b. which states "The Company budgets and manages the PTMM Program at the program level." Explain how the Company budgets the PTMM program spending, and how the Company manages PTMM program spending to ensure the actual cost per mile is in line with the budgeted cost per mile. Provide any reports or analyses the Company has completed which compares the miles of circuits on which the Company expected to complete PTMM for a particular year's budget to the actual circuit miles, and actual cost per circuit mile, associated with PTMM circuit miles completed.

Answer: The Company tracks program spending using its financial systems. The Company tracks PTMM Program investments and miles completed in total at the program level.

Attachment: N/A

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-15.38a

Respondent: M. Elliott Andahazy

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- Question:** 38. Refer to the Company's response to MNSCDE-8.20b which states "The Company budgets and manages the URD Replacement Program at the program level."
- a. Explain how the Company budgets URD program spending, and how the Company manages URD program spending to ensure the actual cost per mile is in line with the budgeted cost per mile. Provide any reports or analyses the Company has completed which compares the miles of circuits on which the Company expected to complete URD replacement for a particular year's budget to the actual circuit miles, and actual cost per circuit mile, associated with URD circuit miles completed.

Answer: The Company objects for the reasons that the information requested consists of confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which is contrary to contractual rights of third parties and/or would cause the Company, its ratepayers, and its customers competitive harm. Without waiving these objections, but subject to them, the Company responds as follows:

The Company tracks program spending using its financial systems. The Company tracks URD Replacement Program investments and feet completed in total at the program level.

Please see attached file.

Attachment: NDA U-21534 MNSCDE-15.38a-01 URD Program Investment per Thousand Feet Analysis

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-15.47a

Respondent: M. Elliott Andahazy

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Question: 47. Refer to the Company's response to MNSCDE-8.21b which states "The Company budgets and manages the Breaker Replacement Program at the program level."

- a. Explain how the Company budgets Breaker Replacement program spending, and how the Company manages program spending to ensure the actual cost per breaker replaced is in line with the budgeted cost per breaker replaced. Provide any reports or analyses the Company has completed which compares the cost per breaker the Company expected in its budgets to the actual cost per breaker replaced.

Answer: The Company objects for the reasons that the information requested consists of confidential, proprietary, research and development of trade secrets, or commercial information, the disclosure of which is contrary to contractual rights of third parties and/or would cause the Company, its ratepayers, and its customers competitive harm. Without waiving these objections, but subject to them, the Company responds as follows:

The Company tracks program spending using its financial systems. The Company tracks Breaker Replacement Program investments and feet completed in total at the program level.

Please see attached file.

Attachment: NDA U-21534 MNSCDE-15.47a-01 Breaker Program Investment per Breaker

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-3.6

Respondent: M. Elliott Andahazy

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Question: Refer to Case No. U-21297 and the Company's discovery response attachment labeled "U-21297 MNSCDE-3.59a-01 4.8kV Hardening Source Data". The consistent framework employed in all tabs of the spreadsheet provides data "3 years before", "2 years before", "1 year before", "3-year Avg (before)", and "1 year after." Please update this entire worksheet and all tabs with data "2 years after", "3 years after" and "3-year Avg After".

Answer: Please see attached file.

Attachment: U-21534 MNSCDE-3.6-01 4.8kV Hardening Data

Michigan Public Service Commission

DTE Electric Company

Discovery Response: U-21534 MNSCDE-3.6-01

4.8kV Hardening Data

U-21534 MNSCDE-3.6-01 4.8kV Hardening Data

Total 2018-2020		725,105	722,592	721,317	723,005	734,851	744,719	737,117	738,896
Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3715	-	-	-	-	-	-	-	-
2018	Circuit3720	-	-	-	-	-	-	-	-
2018	Circuit206	568	568	568	568	-	569	559	376
2018	Circuit208	859	859	857	858	-	861	857	573
2018	Circuit209	1,347	1,347	1,352	1,349	-	1354	1355	903
2018	Circuit211	1,386	1,386	1,385	1,386	-	1400	1400	933
2018	Circuit2434	652	652	652	652	653	654	656	654
2018	Circuit2436	804	804	807	805	808	809	806	808
2018	Circuit2438	154	154	154	154	146	197	197	180
2018	Circuit2439	709	709	712	710	714	718	718	717
2018	Circuit3624	-	-	-	-	-	0	0	-
2018	Circuit2440	544	544	545	544	547	549	549	548
2018	Circuit2441	69	69	67	68	65	57	57	60
2018	Circuit2442	979	979	981	980	984	988	987	986
2018	Circuit2443	641	641	645	642	648	678	677	668
2018	Circuit2444	706	706	704	705	703	703	705	704
2018	Circuit2445	627	627	627	627	632	632	632	632
2018	Circuit2446	780	780	760	773	761	785	785	777
2018	Circuit2447	1,044	1,044	1,042	1,043	1,041	1044	1042	1,042
2018	Circuit4037	-	-	-	-	-	-	-	-
2018	Circuit4038	-	-	-	-	-	-	-	-
2018	Circuit4039	-	-	-	-	-	-	-	-
2018	Circuit4040	-	-	-	-	-	-	-	-
2018	Circuit4041	-	-	-	-	-	-	-	-
2018	Circuit4042	-	-	-	-	-	-	-	-
2018	Circuit4043	-	-	-	-	-	-	-	-
2018	Circuit3625	-	-	-	-	-	0	0	-
2018	Circuit2455	91	91	88	90	84	89	91	88
2018	Circuit2460	280	280	281	280	279	282	284	282
2018	Circuit2466	3	3	3	3	3	7	8	6
2018	Circuit2472	136	136	108	127	105	108	111	108
2018	Circuit2473	743	743	759	748	765	795	798	786
2018	Circuit2474	734	734	680	716	679	808	811	766
2018	Circuit1595	-	-	-	-	-	0	0	-
2018	Circuit1596	23	23	23	23	19	32	33	28
2018	Circuit1597	119	119	126	121	121	125	125	124
2018	Circuit1598	908	908	918	911	949	1021	1036	1,002
2018	Circuit1599	616	616	619	617	614	711	714	680
2018	Circuit1600	911	911	892	905	912	943	949	935
2018	Circuit1601	854	854	853	854	860	716	721	766
2018	Circuit1602	539	539	551	543	555	563	564	561
2018	Circuit1603	698	698	700	699	700	720	722	714
2018	Circuit1604	748	748	742	746	747	788	809	781
2018	Circuit1605	901	901	898	900	930	996	1000	975
2018	Circuit1606	769	769	770	769	769	670	670	703

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1607	787	787	794	789	803	773	800	792
2018	Circuit3741	-	-	-	-	-	-	-	-
2018	Circuit1219	335	335	337	336	335	651	348	445
2018	Circuit4095	-	-	-	-	-	-	-	-
2018	Circuit2015	85	85	85	85	85	88	87	87
2018	Circuit2016	587	587	584	586	585	574	578	579
2018	Circuit2017	596	596	595	596	588	608	611	602
2018	Circuit2527	-	-	-	-	-	0	0	-
2018	Circuit4096	-	-	-	-	-	-	-	-
2018	Circuit2019	24	24	26	25	26	28	28	27
2018	Circuit2020	190	190	188	189	185	193	194	191
2018	Circuit2021	-	-	-	-	-	0	0	-
2018	Circuit2022	795	795	805	798	809	743	745	766
2018	Circuit2023	803	803	803	803	804	808	1058	890
2018	Circuit2024	440	440	441	440	441	445	445	444
2018	Circuit2025	608	608	607	608	602	1569	1568	1,246
2018	Circuit1622	681	681	677	680	677	709	708	698
2018	Circuit1623	479	479	477	478	478	481	483	481
2018	Circuit1624	1,556	1,556	1,560	1,557	1,553	1117	1117	1,262
2018	Circuit1625	13	13	12	13	11	12	12	12
2018	Circuit1626	567	567	566	567	564	735	771	690
2018	Circuit1627	739	739	741	740	741	743	738	741
2018	Circuit1628	-	-	-	-	-	0	0	-
2018	Circuit3728	-	-	-	-	-	-	-	-
2018	Circuit1629	695	695	692	694	693	696	694	694
2018	Circuit1630	893	893	894	893	897	899	900	899
2018	Circuit1631	583	583	583	583	583	583	584	583
2018	Circuit1632	624	624	625	624	625	627	631	628
2018	Circuit1633	1,124	1,124	1,121	1,123	1,121	1135	1136	1,131
2018	Circuit2559	644	644	643	644	640	647	647	645
2018	Circuit1634	385	385	385	385	385	384	383	384
2018	Circuit2566	161	161	158	160	154	160	161	158
2018	Circuit1392	312	312	783	469	788	0	0	263
2018	Circuit3761	474	474	-	316	-	-	-	-
2018	Circuit2578	1,280	1,280	1,279	1,280	1,289	1288	1288	1,288
2018	Circuit2579	733	733	737	734	738	739	741	739
2018	Circuit3730	-	-	-	-	-	-	-	-
2018	Circuit1237	182	182	181	182	177	181	179	179
2018	Circuit1238	1	1	1	1	-	1	1	1
2018	Circuit1239	328	328	326	327	327	327	328	327
2018	Circuit1240	267	267	269	268	268	266	265	266
2018	Circuit1241	-	-	-	-	-	0	0	-
2018	Circuit1242	362	362	361	362	359	361	362	361
2018	Circuit1243	471	471	459	467	487	488	466	480
2018	Circuit1244	639	639	634	637	628	635	635	633
2018	Circuit1245	555	555	554	555	557	558	558	558
2018	Circuit1246	432	432	430	431	432	348	345	375
2018	Circuit3710	-	-	-	-	-	-	-	-
2018	Circuit820	12	12	12	12	11	12	11	11

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit825	5	5	7	6	5	6	7	6
2018	Circuit826	83	83	84	83	83	88	89	87
2018	Circuit827	68	68	83	73	79	109	116	101
2018	Circuit828	790	790	790	790	796	864	902	854
2018	Circuit829	1,029	1,029	992	1,017	1,028	1118	1124	1,090
2018	Circuit830	764	764	739	756	760	836	835	810
2018	Circuit831	37	37	35	36	34	34	34	34
2018	Circuit832	629	629	626	628	665	715	730	703
2018	Circuit833	404	404	372	393	394	426	454	425
2018	Circuit834	242	242	229	238	226	245	255	242
2018	Circuit835	637	637	603	626	613	643	675	644
2018	Circuit836	690	690	640	673	673	708	734	705
2018	Circuit837	251	251	245	249	239	253	256	249
2018	Circuit838	786	786	677	750	722	731	785	746
2018	Circuit1641	61	61	63	62	62	98	100	87
2018	Circuit1646	434	434	426	431	439	483	504	475
2018	Circuit1642	601	601	601	601	631	693	706	677
2018	Circuit1647	1,000	1,000	1,026	1,009	1,069	1130	1149	1,116
2018	Circuit1643	653	653	648	651	668	706	717	697
2018	Circuit1648	990	990	1,001	994	1,031	1166	1211	1,136
2018	Circuit1644	901	901	908	903	938	1023	1078	1,013
2018	Circuit1645	420	420	403	414	421	474	477	457
2018	Circuit1649	486	486	505	492	515	544	541	533
2018	Circuit55	995	995	1,001	997	1,027	1083	1105	1,072
2018	Circuit57	573	573	579	575	591	609	612	604
2018	Circuit59	869	869	874	871	870	886	885	880
2018	Circuit60	947	947	980	958	998	1080	1081	1,053
2018	Circuit62	440	440	399	426	395	396	438	410
2018	Circuit63	944	944	947	945	962	1047	1057	1,022
2018	Circuit64	1,033	1,033	1,047	1,038	1,065	1141	1175	1,127
2018	Circuit2666	-	-	-	-	-	-	-	-
2018	Circuit4093	-	-	-	-	-	-	-	-
2018	Circuit3638	1	1	-	1	-	0	0	-
2018	Circuit4097	-	-	-	-	-	-	-	-
2018	Circuit3639	-	-	1	0	-	0	0	-
2018	Circuit4098	-	-	-	-	-	-	-	-
2018	Circuit3578	538	538	532	536	-	0	0	-
2018	Circuit2679	-	-	-	-	-	30	30	20
2018	Circuit2681	-	-	-	-	-	950	1057	669
2018	Circuit3736	-	-	-	-	-	-	-	-
2018	Circuit3733	-	-	-	-	-	-	-	-
2018	Circuit1663	310	310	307	309	302	309	311	307
2018	Circuit1664	713	713	719	715	717	721	724	721
2018	Circuit1665	515	515	517	516	518	520	519	519
2018	Circuit1666	1,321	1,321	1,329	1,324	1,327	1336	1101	1,255
2018	Circuit1668	802	802	790	798	793	799	798	797
2018	Circuit1669	992	992	991	992	992	1051	972	1,005
2018	Circuit852	622	622	535	593	534	540	548	541
2018	Circuit853	666	666	669	667	662	669	683	671

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit854	942	942	932	939	977	1007	1019	1,001
2018	Circuit855	572	572	563	569	575	614	621	603
2018	Circuit856	-	-	-	-	-	0	0	-
2018	Circuit857	816	816	799	810	820	875	896	864
2018	Circuit858	91	91	90	91	88	91	91	90
2018	Circuit859	320	320	318	319	315	374	364	351
2018	Circuit3743	-	-	-	-	-	-	-	-
2018	Circuit860	820	820	827	822	852	783	854	830
2018	Circuit861	1,032	1,032	1,029	1,031	1,033	1034	932	1,000
2018	Circuit862	583	583	583	583	580	582	583	582
2018	Circuit863	416	416	785	539	780	737	747	755
2018	Circuit864	661	661	338	553	335	340	338	338
2018	Circuit865	618	618	633	623	633	649	665	649
2018	Circuit3742	-	-	-	-	-	-	-	-
2018	Circuit3739	-	-	-	-	-	-	-	-
2018	Circuit3711	-	-	-	-	-	-	-	-
2018	Circuit3751	-	-	-	-	-	-	-	-
2018	Circuit1684	523	523	527	524	527	529	527	528
2018	Circuit1685	1,037	1,037	1,039	1,038	1,038	1041	1041	1,040
2018	Circuit1686	1,290	1,290	1,287	1,289	1,299	1295	1297	1,297
2018	Circuit1687	779	779	779	779	778	784	787	783
2018	Circuit1688	1,413	1,413	1,420	1,415	1,426	1424	1421	1,424
2018	Circuit2729	4	4	4	4	3	5	5	4
2018	Circuit2730	7	7	8	7	5	6	7	6
2018	Circuit2731	-	-	-	-	-	0	0	-
2018	Circuit2732	3	3	3	3	3	4	5	4
2018	Circuit2733	56	56	57	56	52	61	61	58
2018	Circuit2734	451	451	457	453	458	337	340	378
2018	Circuit2737	1,045	1,045	1,033	1,041	1,056	1064	1063	1,061
2018	Circuit2738	372	372	375	373	381	509	516	469
2018	Circuit2739	933	933	932	933	935	936	938	936
2018	Circuit2740	1,161	1,161	1,169	1,164	1,176	1175	1174	1,175
2018	Circuit2741	650	650	644	648	663	674	676	671
2018	Circuit2742	1,336	1,336	1,335	1,336	1,368	1467	1460	1,432
2018	Circuit2744	775	775	785	778	791	803	804	799
2018	Circuit2745	820	820	818	819	818	822	822	821
2018	Circuit2746	976	976	975	976	976	977	982	978
2018	Circuit2752	-	-	1,109	370	1,107	1113	1110	1,110
2018	Circuit2753	833	833	832	833	836	839	843	839
2018	Circuit2754	858	858	865	860	866	872	870	869
2018	Circuit2755	597	597	603	599	601	605	607	604
2018	Circuit2756	323	323	323	323	327	327	328	327
2018	Circuit4087	-	-	-	-	-	-	-	-
2018	Circuit875	657	657	652	655	657	667	666	663
2018	Circuit876	1,129	1,129	1,127	1,128	1,155	1184	1191	1,177
2018	Circuit4099	-	-	-	-	-	-	-	-
2018	Circuit4100	-	-	-	-	-	-	-	-
2018	Circuit3712	1,110	1,110	-	740	-	-	-	-
2018	Circuit3716	-	-	-	-	-	-	-	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3641	-	-	-	-	-	0	0	-
2018	Circuit1698	794	794	654	747	646	759	755	720
2018	Circuit3587	686	686	678	683	661	0	0	220
2018	Circuit1699	1,215	1,215	882	1,104	879	888	887	885
2018	Circuit1700	1,094	1,094	686	958	670	691	691	684
2018	Circuit1701	1,008	1,008	1,010	1,009	999	0	0	333
2018	Circuit3588	1,205	1,205	1,206	1,205	1,203	0	0	401
2018	Circuit2056	28	28	31	29	28	39	37	35
2018	Circuit2057	7	7	8	7	7	12	12	10
2018	Circuit2058	-	-	-	-	-	0	0	-
2018	Circuit2059	716	716	702	711	703	728	731	721
2018	Circuit2060	647	647	647	647	647	648	646	647
2018	Circuit2061	688	688	686	687	679	689	694	687
2018	Circuit2062	615	615	614	615	610	616	617	614
2018	Circuit4088	-	-	-	-	-	-	-	-
2018	Circuit1702	957	957	968	961	985	1029	1029	1,014
2018	Circuit1703	1,111	1,111	1,144	1,122	1,170	1304	1283	1,252
2018	Circuit1704	1,317	1,317	1,359	1,331	1,393	1471	1459	1,441
2018	Circuit2790	478	478	478	478	470	487	488	482
2018	Circuit2791	675	675	673	674	673	834	675	727
2018	Circuit2792	496	496	491	494	495	502	501	499
2018	Circuit3750	-	-	-	-	-	-	-	-
2018	Circuit2794	397	397	397	397	393	405	410	403
2018	Circuit3754	-	-	-	-	-	-	-	-
2018	Circuit2795	-	-	-	-	-	1	1	1
2018	Circuit2796	49	49	47	48	46	47	47	47
2018	Circuit2798	4	4	4	4	-	0	0	-
2018	Circuit2801	605	605	605	605	607	611	612	610
2018	Circuit2802	12	12	12	12	12	12	12	12
2018	Circuit2803	42	42	42	42	41	42	40	41
2018	Circuit2804	768	768	767	768	766	770	769	768
2018	Circuit2805	802	802	802	802	804	792	805	800
2018	Circuit2806	137	137	136	137	135	139	141	138
2018	Circuit2807	756	756	757	756	754	756	762	757
2018	Circuit2808	659	659	657	658	655	667	659	660
2018	Circuit2810	204	204	203	204	207	206	208	207
2018	Circuit879	17	17	17	17	13	15	16	15
2018	Circuit880	-	-	-	-	-	1	1	1
2018	Circuit881	1	1	1	1	1	1	1	1
2018	Circuit882	29	29	31	30	27	28	29	28
2018	Circuit883	140	140	140	140	142	146	146	145
2018	Circuit884	34	34	29	32	20	30	29	26
2018	Circuit886	10	10	10	10	8	11	11	10
2018	Circuit887	266	266	269	267	280	496	511	429
2018	Circuit888	379	379	336	365	334	406	447	396
2018	Circuit889	945	945	1,006	965	1,032	1482	1526	1,347
2018	Circuit892	840	840	852	844	845	702	706	751
2018	Circuit893	135	135	132	134	130	132	143	135
2018	Circuit2063	336	336	335	336	334	342	329	335

Year	Circuit	Customer Count Control Group						
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after
2018	Circuit3745	-	-	-	-	-	-	-
2018	Circuit3755	-	-	-	-	-	-	-
2018	Circuit3718	-	-	-	-	-	-	-
2018	Circuit2066	-	-	-	-	-	0	0
2018	Circuit2067	187	187	219	198	209	215	218
2018	Circuit2068	1,038	1,038	1,010	1,029	1,005	1019	1022
2018	Circuit2069	861	861	678	800	675	679	676
2018	Circuit2070	940	940	864	915	866	723	721
2018	Circuit2071	821	821	593	745	595	599	600
2018	Circuit2072	438	438	437	438	434	448	448
2018	Circuit3740	-	-	-	-	-	-	-
2018	Circuit2076	307	307	307	307	299	301	294
2018	Circuit2077	491	491	493	492	495	499	497
2018	Circuit2078	680	680	682	681	684	676	677
2018	Circuit2079	-	-	-	-	-	0	0
2018	Circuit2080	646	646	644	645	641	651	652
2018	Circuit2081	546	546	548	547	546	548	548
2018	Circuit2082	763	763	763	763	763	771	770
2018	Circuit895	7	7	7	7	5	5	5
2018	Circuit3622	-	-	-	-	-	-	-
2018	Circuit3643	5	5	-	3	5	0	0
2018	Circuit896	4	4	4	4	3	4	4
2018	Circuit3623	131	131	132	131	132	-	-
2018	Circuit4101	-	-	-	-	-	-	-
2018	Circuit897	190	190	191	190	191	195	192
2018	Circuit898	-	-	-	-	-	0	0
2018	Circuit901	111	111	114	112	109	112	113
2018	Circuit903	195	195	187	192	184	189	191
2018	Circuit904	369	369	357	365	353	322	331
2018	Circuit3734	-	-	-	-	-	-	-
2018	Circuit1708	1,035	1,035	1,050	1,040	1,089	1144	1135
2018	Circuit1713	1,110	1,110	1,121	1,114	1,130	1129	1135
2018	Circuit1709	706	706	712	708	732	742	743
2018	Circuit1712	676	676	680	677	682	682	682
2018	Circuit1715	527	527	532	529	537	560	565
2018	Circuit4102	-	-	-	-	-	-	-
2018	Circuit4103	-	-	-	-	-	-	-
2018	Circuit2083	783	783	785	784	784	761	784
2018	Circuit2084	583	583	582	583	583	579	578
2018	Circuit2085	780	780	781	780	790	790	792
2018	Circuit2086	-	-	-	-	-	0	0
2018	Circuit3731	-	-	-	-	-	-	-
2018	Circuit2087	381	381	389	384	392	716	720
2018	Circuit2088	1,664	1,664	1,680	1,669	1,687	1666	1663
2018	Circuit910	-	-	-	-	-	0	0
2018	Circuit911	13	13	11	12	9	11	13
2018	Circuit912	35	35	33	34	33	32	33
2018	Circuit913	353	353	341	349	343	358	378
2018	Circuit916	401	401	418	407	423	414	420

4.8KV Hardening Data		Customer Count Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit919	1,002	1,002	995	1,000	1,037	1114	1194	1,115
2018	Circuit3744	-	-	-	-	-	-	-	-
2018	Circuit1716	-	-	-	-	-	0	0	-
2018	Circuit1717	20	20	22	21	20	26	26	24
2018	Circuit1719	3	3	3	3	1	4	4	3
2018	Circuit1721	4	4	4	4	3	3	3	3
2018	Circuit1726	-	-	-	-	-	0	0	-
2018	Circuit4104	-	-	-	-	-	-	-	-
2018	Circuit1727	36	36	40	37	25	28	28	27
2018	Circuit1728	102	102	102	102	99	103	100	101
2018	Circuit1729	11	11	11	11	33	38	38	36
2018	Circuit1730	17	17	18	17	14	18	17	16
2018	Circuit1732	1,046	1,046	922	1,005	1,044	1091	1098	1,078
2018	Circuit1733	767	767	768	767	771	774	772	772
2018	Circuit1734	940	940	946	942	945	887	944	925
2018	Circuit1735	871	871	873	872	871	1018	1017	969
2018	Circuit1736	778	778	781	779	783	783	783	783
2018	Circuit1737	991	991	995	992	979	982	982	981
2018	Circuit1738	1,273	1,273	1,283	1,276	1,288	1477	1473	1,413
2018	Circuit1739	818	818	825	820	827	844	845	839
2018	Circuit4094	-	-	-	-	-	-	-	-
2018	Circuit933	168	168	160	165	160	160	184	168
2018	Circuit934	1,296	1,296	1,311	1,301	1,307	1202	1357	1,289
2018	Circuit935	1,522	1,522	1,544	1,529	1,532	1596	1612	1,580
2018	Circuit936	307	307	283	299	277	305	317	300
2018	Circuit937	832	832	806	823	821	898	932	884
2018	Circuit938	1,001	1,001	1,038	1,013	1,055	1114	1130	1,100
2018	Circuit939	1,556	1,556	1,570	1,561	1,564	1613	1609	1,595
2018	Circuit2859	680	680	679	680	682	695	683	687
2018	Circuit1401	361	361	371	364	371	383	384	379
2018	Circuit1402	679	679	678	679	678	685	684	682
2018	Circuit3738	-	-	-	-	-	-	-	-
2018	Circuit4105	-	-	-	-	-	-	-	-
2018	Circuit3644	1	1	1	1	-	2	0	1
2018	Circuit3756	-	-	-	-	-	-	-	-
2018	Circuit2862	21	21	21	21	16	20	20	19
2018	Circuit2863	32	32	30	31	29	34	100	54
2018	Circuit2864	197	197	202	199	202	215	212	210
2018	Circuit2865	737	737	737	737	737	743	746	742
2018	Circuit2866	806	806	809	807	803	817	817	812
2018	Circuit2867	-	-	-	-	-	0	0	-
2018	Circuit2868	1,365	1,365	1,364	1,365	1,367	1373	1306	1,349
2018	Circuit2869	538	538	541	539	543	543	540	542
2018	Circuit2870	1,356	1,356	1,367	1,360	1,371	1377	1378	1,375
2018	Circuit2877	877	877	871	875	875	1200	879	985
2018	Circuit2878	-	-	-	-	-	0	0	-
2018	Circuit2879	516	516	514	515	517	1100	516	711
2018	Circuit2881	1,203	1,203	1,196	1,201	1,203	118	1203	841
2018	Circuit2882	310	310	310	310	310	450	316	359

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2884	891	891	890	891	895	243	903	680
2018	Circuit2885	1,747	1,747	1,741	1,745	1,743	11	1748	1,167
2018	Circuit2886	686	686	683	685	684	673	684	680
2018	Circuit2887	534	534	534	534	534	1321	539	798
2018	Circuit2888	944	944	962	950	967	4027	1062	2,019
2018	Circuit2889	836	836	836	836	840	850	846	845
2018	Circuit2890	762	762	760	761	761	1497	764	1,007
2018	Circuit2894	543	543	556	547	559	571	602	577
2018	Circuit2895	634	634	636	635	629	634	634	632
2018	Circuit1740	4	4	4	4	3	3	3	3
2018	Circuit1741	903	903	900	902	901	904	904	903
2018	Circuit1743	1,307	1,307	1,324	1,313	1,337	1357	1369	1,354
2018	Circuit1744	-	-	-	-	-	0	0	-
2018	Circuit1745	808	808	806	807	809	670	669	716
2018	Circuit1746	1,191	1,191	1,188	1,190	1,191	1195	1195	1,194
2018	Circuit1748	798	798	810	802	809	742	820	790
2018	Circuit1749	841	841	845	842	840	843	845	843
2018	Circuit1750	912	912	911	912	908	954	950	937
2018	Circuit1751	1,007	1,007	978	997	984	1019	1033	1,012
2018	Circuit3727	-	-	-	-	-	-	-	-
2018	Circuit3719	-	-	-	-	-	-	-	-
2018	Circuit3590	18	18	18	18	16	0	0	5
2018	Circuit3591	61	61	60	61	55	0	0	18
2018	Circuit3592	794	794	715	768	897	0	0	299
2018	Circuit3594	544	544	516	535	368	0	0	123
2018	Circuit3595	1,090	1,090	1,096	1,092	1,083	0	0	361
2018	Circuit1752	325	325	327	326	326	327	326	326
2018	Circuit1753	506	506	508	507	507	518	518	514
2018	Circuit1759	691	691	689	690	692	691	692	692
2018	Circuit1754	545	545	543	544	545	545	549	546
2018	Circuit1755	409	409	409	409	408	408	409	408
2018	Circuit1756	548	548	546	547	547	544	548	546
2018	Circuit4106	-	-	-	-	-	-	-	-
2018	Circuit3646	1	1	-	1	-	0	0	-
2018	Circuit940	-	-	-	-	-	0	0	-
2018	Circuit941	141	141	149	144	147	317	321	262
2018	Circuit942	5	5	5	5	4	5	5	5
2018	Circuit943	347	347	350	348	348	361	199	303
2018	Circuit2931	-	-	-	-	-	0	0	-
2018	Circuit2932	390	390	394	391	408	399	420	409
2018	Circuit2933	750	750	756	752	755	753	751	753
2018	Circuit2934	1,095	1,095	1,108	1,099	1,126	1144	1152	1,141
2018	Circuit2935	1,024	1,024	1,041	1,030	1,064	1083	1096	1,081
2018	Circuit2936	116	116	112	115	110	117	116	114
2018	Circuit2937	299	299	312	303	315	315	319	316
2018	Circuit1764	-	-	-	-	-	0	0	-
2018	Circuit1765	-	-	-	-	-	0	0	-
2018	Circuit1250	20	20	16	19	15	17	17	16
2018	Circuit1252	331	331	329	330	328	364	364	352

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1253	1,065	1,065	1,059	1,063	1,071	1082	1087	1,080
2018	Circuit1255	941	941	930	937	936	944	953	944
2018	Circuit1256	1,348	1,348	1,341	1,346	899	904	1330	1,044
2018	Circuit1257	176	176	154	169	157	153	149	153
2018	Circuit944	358	358	468	395	475	529	527	510
2018	Circuit945	27	27	28	27	23	28	27	26
2018	Circuit946	281	281	283	282	272	448	636	452
2018	Circuit947	172	172	169	171	159	221	224	201
2018	Circuit3649	2	2	2	2	1	0	0	0
2018	Circuit3650	-	-	-	-	-	0	0	-
2018	Circuit3651	-	-	-	-	-	0	0	-
2018	Circuit1766	890	445	497	611	491	508	507	502
2018	Circuit1768	432	432	433	432	425	437	437	433
2018	Circuit1769	658	658	657	658	650	659	659	656
2018	Circuit1771	8	8	8	8	4	12	13	10
2018	Circuit1772	368	368	368	368	365	372	372	370
2018	Circuit1773	833	833	767	811	782	831	831	815
2018	Circuit1774	552	552	551	552	548	677	678	634
2018	Circuit2971	1,193	1,193	1,188	1,191	1,168	1578	1216	1,321
2018	Circuit2973	1,420	1,420	1,420	1,420	1,420	908	1426	1,251
2018	Circuit948	-	-	-	-	-	1	1	1
2018	Circuit950	291	291	280	287	284	284	306	291
2018	Circuit951	414	414	389	406	400	441	422	421
2018	Circuit952	531	531	523	528	532	543	557	544
2018	Circuit953	483	483	453	473	467	467	483	472
2018	Circuit954	604	604	591	600	591	598	611	600
2018	Circuit955	387	387	365	380	367	368	385	373
2018	Circuit4089	-	-	-	-	-	-	-	-
2018	Circuit2992	-	-	-	-	-	0	0	-
2018	Circuit2993	23	23	24	23	20	23	21	21
2018	Circuit2994	51	51	51	51	22	22	49	31
2018	Circuit2995	868	868	855	864	865	871	877	871
2018	Circuit2996	678	678	678	678	682	683	685	683
2018	Circuit2997	467	467	465	466	467	471	470	469
2018	Circuit2998	980	980	983	981	983	991	994	989
2018	Circuit2999	723	723	724	723	718	721	722	720
2018	Circuit3737	-	-	-	-	-	-	-	-
2018	Circuit957	341	341	296	326	905	1000	1038	981
2018	Circuit958	561	561	528	550	541	-	-	541
2018	Circuit959	-	-	-	-	-	0	0	-
2018	Circuit960	944	944	1,303	1,064	1,335	1426	1477	1,413
2018	Circuit3656	-	-	-	-	-	0	0	-
2018	Circuit4107	-	-	-	-	-	-	-	-
2018	Circuit3598	74	74	-	49	168	0	0	56
2018	Circuit3041	547	547	553	549	557	563	566	562
2018	Circuit3056	100	100	100	100	94	105	111	103
2018	Circuit3064	406	406	406	406	404	411	355	390
2018	Circuit3065	906	906	906	906	900	920	907	909
2018	Circuit3066	880	880	855	872	857	855	856	856

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3068	-	-	1	0	-	1	1	1
2018	Circuit3069	12	12	12	12	8	13	12	11
2018	Circuit1779	810	810	807	809	799	766	757	774
2018	Circuit3070	534	534	535	534	532	538	526	532
2018	Circuit3071	645	645	642	644	639	645	653	646
2018	Circuit3072	290	290	289	290	287	1115	1121	841
2018	Circuit3073	554	554	550	553	549	560	610	573
2018	Circuit3074	670	670	669	670	669	904	906	826
2018	Circuit1780	37	37	37	37	33	362	384	260
2018	Circuit1781	3	3	-	2	-	0	0	-
2018	Circuit1782	21	21	22	21	20	20	22	21
2018	Circuit1783	17	17	17	17	16	17	18	17
2018	Circuit4108	-	-	-	-	-	-	-	-
2018	Circuit1785	43	43	40	42	36	40	39	38
2018	Circuit1786	1	1	-	1	-	1	1	1
2018	Circuit1788	7	7	7	7	7	8	9	8
2018	Circuit1789	712	712	708	711	710	730	714	718
2018	Circuit1790	728	728	719	725	712	412	411	512
2018	Circuit1791	649	649	644	647	639	670	668	659
2018	Circuit1792	1,385	1,385	1,367	1,379	1,373	1434	1439	1,415
2018	Circuit1793	485	485	483	484	479	469	468	472
2018	Circuit1794	878	878	896	884	906	942	935	928
2018	Circuit1795	208	208	211	209	204	241	239	228
2018	Circuit4109	-	-	-	-	-	-	-	-
2018	Circuit3657	14	14	52	27	-	0	0	-
2018	Circuit3658	2	2	-	1	-	0	0	-
2018	Circuit3606	-	-	27	9	29	0	0	10
2018	Circuit3607	110	110	8	76	2	0	0	1
2018	Circuit3608	56	56	2	38	1	0	0	0
2018	Circuit3609	14	14	5	11	4	0	0	1
2018	Circuit3659	-	-	-	-	-	0	0	-
2018	Circuit3660	-	-	-	-	-	0	0	-
2018	Circuit3661	3	3	3	3	3	0	0	1
2018	Circuit3713	1,074	1,074	-	716	-	-	-	-
2018	Circuit3662	-	-	-	-	-	0	0	-
2018	Circuit3663	52	52	49	51	48	0	0	16
2018	Circuit3611	177	177	151	168	158	0	0	53
2018	Circuit3714	653	653	-	435	-	-	-	-
2018	Circuit3094	-	-	-	-	-	0	0	-
2018	Circuit3096	34	34	35	34	30	37	36	34
2018	Circuit3097	1,183	1,183	1,189	1,185	1,197	1204	1198	1,200
2018	Circuit3099	1,018	1,018	1,014	1,017	1,017	1023	1023	1,021
2018	Circuit3747	-	-	-	-	-	-	-	-
2018	Circuit3100	617	617	622	619	622	627	626	625
2018	Circuit3101	1,195	1,195	1,195	1,195	1,201	1203	1242	1,215
2018	Circuit3102	881	881	878	880	879	886	886	884
2018	Circuit3758	-	-	-	-	-	-	-	-
2018	Circuit1798	772	772	759	768	783	860	885	843
2018	Circuit1799	1,058	1,058	1,037	1,051	1,072	1177	1213	1,154

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1800	661	661	641	654	672	729	766	722
2018	Circuit1801	785	785	802	791	829	911	938	893
2018	Circuit1802	740	740	737	739	766	841	883	830
2018	Circuit1803	29	29	27	28	27	33	35	32
2018	Circuit1804	554	554	532	547	548	596	623	589
2018	Circuit1805	22	22	22	22	17	22	22	20
2018	Circuit1806	48	48	47	48	44	51	52	49
2018	Circuit1807	10	10	10	10	8	11	11	10
2018	Circuit1808	-	-	-	-	-	0	0	-
2018	Circuit1809	567	567	569	568	568	564	565	566
2018	Circuit1423	-	-	-	-	-	0	0	-
2018	Circuit3124	37	37	37	37	36	37	38	37
2018	Circuit3126	23	23	25	24	20	28	28	25
2018	Circuit3127	-	-	-	-	-	0	0	-
2018	Circuit3128	-	-	-	-	-	0	0	-
2018	Circuit3665	-	-	-	-	-	0	0	-
2018	Circuit3131	853	853	859	855	870	927	946	914
2018	Circuit3748	-	-	-	-	-	-	-	-
2018	Circuit4090	-	-	-	-	-	-	-	-
2018	Circuit1812	64	64	65	64	59	62	65	62
2018	Circuit1815	23	23	26	24	23	25	24	24
2018	Circuit1816	2	2	2	2	2	2	2	2
2018	Circuit1817	2	2	1	2	1	2	2	2
2018	Circuit3667	13	13	-	9	-	0	0	-
2018	Circuit1818	11	11	11	11	9	11	11	10
2018	Circuit1819	38	38	39	38	30	38	39	36
2018	Circuit1820	431	431	431	431	444	468	483	465
2018	Circuit1821	812	812	811	812	797	803	807	802
2018	Circuit1822	81	81	73	78	67	69	71	69
2018	Circuit1823	1,313	1,313	1,322	1,316	1,327	1336	1334	1,332
2018	Circuit1824	1,166	1,166	1,205	1,179	1,220	1263	1288	1,257
2018	Circuit1825	1,195	1,195	1,208	1,199	1,209	1214	1214	1,212
2018	Circuit1826	805	805	808	806	809	815	814	813
2018	Circuit3156	-	-	1	0	-	5	8	4
2018	Circuit1265	56	56	55	56	52	-	-	52
2018	Circuit1266	9	9	9	9	4	35	38	26
2018	Circuit1268	3	3	3	3	2	5	5	4
2018	Circuit1269	-	-	-	-	-	0	0	-
2018	Circuit1270	-	-	-	-	-	0	0	-
2018	Circuit1271	24	24	24	24	24	24	25	24
2018	Circuit1272	21	21	21	21	18	24	24	22
2018	Circuit1274	1,151	1,151	1,147	1,150	1,167	1168	1177	1,171
2018	Circuit1275	822	822	729	791	737	838	835	803
2018	Circuit1276	665	665	668	666	670	673	673	672
2018	Circuit1827	499	499	502	500	498	501	503	501
2018	Circuit1828	572	572	574	573	577	578	578	578
2018	Circuit1829	249	249	251	250	249	250	252	250
2018	Circuit1830	694	694	687	692	689	692	689	690
2018	Circuit3184	73	73	73	73	72	91	75	79

Michigan Public Service Commission

DTE Electric Company

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4.8kV Hardening Data

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3185	1,673	1,673	1,667	1,671	1,677	1686	1636	1,666
2018	Circuit3186	724	724	720	723	722	704	723	716
2018	Circuit3187	712	712	713	712	714	717	720	717
2018	Circuit3188	388	388	388	388	388	395	448	410
2018	Circuit3189	-	-	-	-	-	0	0	-
2018	Circuit3190	539	539	538	539	538	543	512	531
2018	Circuit3192	1,125	1,125	1,121	1,124	1,125	1130	1128	1,128
2018	Circuit3193	459	459	451	456	450	470	78	333
2018	Circuit3753	-	-	-	-	-	-	-	-
2018	Circuit3194	1,022	1,022	1,021	1,022	1,020	1032	1030	1,027
2018	Circuit3669	-	-	-	-	-	0	0	-
2018	Circuit3195	1,187	1,187	1,182	1,185	1,194	1201	1199	1,198
2018	Circuit1839	518	518	509	515	489	530	532	517
2018	Circuit1845	416	416	415	416	417	420	419	419
2018	Circuit1846	220	220	217	219	220	220	220	220
2018	Circuit1847	302	302	301	302	310	317	317	315
2018	Circuit1848	670	670	670	670	681	770	766	739
2018	Circuit1849	269	269	267	268	265	275	280	273
2018	Circuit1850	11	11	11	11	9	13	10	11
2018	Circuit1851	231	231	229	230	224	235	235	231
2018	Circuit1852	21	21	20	21	17	14	13	15
2018	Circuit1853	147	147	149	148	150	414	416	327
2018	Circuit1854	380	380	391	384	380	123	125	209
2018	Circuit3752	-	-	-	-	-	-	-	-
2018	Circuit4110	-	-	-	-	-	-	-	-
2018	Circuit1433	279	279	279	279	275	276	279	277
2018	Circuit1434	433	433	433	433	433	446	444	441
2018	Circuit1435	464	464	467	465	469	508	483	487
2018	Circuit1436	202	202	204	203	201	206	207	205
2018	Circuit2145	236	236	235	236	232	235	236	234
2018	Circuit2146	698	698	693	696	692	698	704	698
2018	Circuit3253	-	-	-	-	-	0	0	-
2018	Circuit2147	361	361	361	361	359	360	359	359
2018	Circuit1438	-	-	-	-	-	0	0	-
2018	Circuit1300	1,132	1,132	1,129	1,131	1,135	1140	1140	1,138
2018	Circuit1301	1,399	1,399	1,402	1,400	1,407	1405	1407	1,406
2018	Circuit1302	700	700	699	700	702	703	704	703
2018	Circuit4091	-	-	-	-	-	-	-	-
2018	Circuit1303	1,150	1,150	1,148	1,149	1,153	1151	1151	1,152
2018	Circuit1295	840	840	844	841	843	570	572	662
2018	Circuit3749	-	-	-	-	-	-	-	-
2018	Circuit1297	433	433	430	432	432	435	436	434
2018	Circuit1304	1,429	1,429	1,432	1,430	1,439	1442	1445	1,442
2018	Circuit1306	640	640	569	616	635	642	641	639
2018	Circuit1298	453	453	448	451	454	455	456	455
2018	Circuit3717	-	-	-	-	-	-	-	-
2018	Circuit3735	-	-	-	-	-	-	-	-
2018	Circuit975	-	-	54	18	50	51	50	50
2018	Circuit978	24	24	23	24	20	21	21	21

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit979	-	-	-	-	-	0	0	-
2018	Circuit980	-	-	-	-	-	0	0	-
2018	Circuit3677	8	8	-	5	-	0	0	-
2018	Circuit981	1	1	1	1	-	1	1	1
2018	Circuit982	2	2	1	2	1	2	2	2
2018	Circuit983	1	1	1	1	-	0	1	0
2018	Circuit986	3	3	8	5	7	9	9	8
2018	Circuit987	402	402	407	404	399	407	481	429
2018	Circuit988	321	321	316	319	314	312	322	316
2018	Circuit989	641	641	620	634	621	633	641	632
2018	Circuit991	302	302	292	299	298	314	331	314
2018	Circuit992	155	155	116	142	118	131	132	127
2018	Circuit994	882	882	855	873	854	901	901	885
2018	Circuit995	545	545	549	546	1,034	575	591	733
2018	Circuit3302	-	-	-	-	-	0	0	-
2018	Circuit3303	-	-	-	-	-	0	0	-
2018	Circuit1877	1	1	1	1	-	2	2	1
2018	Circuit1878	1,444	1,444	1,443	1,444	1,419	1188	1041	1,216
2018	Circuit1879	23	23	23	23	19	24	25	23
2018	Circuit1880	823	823	836	827	832	844	892	856
2018	Circuit2150	789	789	795	791	793	794	904	830
2018	Circuit3721	-	-	-	-	-	-	-	-
2018	Circuit3314	40	40	40	40	36	37	38	37
2018	Circuit3315	-	-	-	-	-	0	0	-
2018	Circuit3316	349	349	347	348	347	420	344	370
2018	Circuit3317	630	630	632	631	651	1249	637	846
2018	Circuit3318	389	389	383	387	384	390	392	389
2018	Circuit3319	634	634	635	634	633	635	614	627
2018	Circuit3320	1,020	1,020	1,021	1,020	1,029	1031	1031	1,030
2018	Circuit3321	837	837	840	838	840	857	859	852
2018	Circuit3322	407	407	405	406	406	412	410	409
2018	Circuit3323	618	618	617	618	616	389	620	542
2018	Circuit3324	675	675	678	676	679	682	934	765
2018	Circuit3757	-	-	-	-	-	-	-	-
2018	Circuit1455	2	2	2	2	1	2	2	2
2018	Circuit2167	845	845	844	845	842	846	846	845
2018	Circuit2165	562	562	563	562	562	564	565	564
2018	Circuit2166	652	652	654	653	646	736	735	706
2018	Circuit1307	15	15	13	14	11	14	15	13
2018	Circuit1308	61	61	60	61	54	61	64	60
2018	Circuit1309	60	60	60	60	57	61	60	59
2018	Circuit1310	46	46	47	46	44	44	44	44
2018	Circuit1311	42	42	42	42	37	43	24	35
2018	Circuit1312	-	-	-	-	-	1	20	7
2018	Circuit1313	179	179	184	181	184	171	173	176
2018	Circuit1314	-	-	-	-	-	0	0	-
2018	Circuit3395	891	891	878	887	892	998	1055	982
2018	Circuit4111	-	-	-	-	-	-	-	-
2018	Circuit3397	376	376	375	376	375	499	384	419

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3398	545	545	542	544	524	508	539	524
2018	Circuit3399	3	3	3	3	2	4	4	3
2018	Circuit3400	760	760	755	758	756	1803	767	1,109
2018	Circuit1458	645	645	644	645	642	655	658	652
2018	Circuit1459	713	713	682	703	682	718	720	707
2018	Circuit1460	1,055	1,055	1,055	1,055	1,050	1049	1051	1,050
2018	Circuit1461	1	1	1	1	1	0	0	0
2018	Circuit1462	177	177	177	177	174	175	175	175
2018	Circuit1463	417	417	414	416	415	421	423	420
2018	Circuit1464	365	365	366	365	364	363	364	364
2018	Circuit3724	-	-	-	-	-	-	-	-
2018	Circuit4112	-	-	-	-	-	-	-	-
2018	Circuit1907	2	2	2	2	3	3	5	4
2018	Circuit1908	144	144	144	144	142	145	146	144
2018	Circuit1910	667	667	655	663	655	676	679	670
2018	Circuit1912	1,533	1,533	1,536	1,534	1,529	1526	1527	1,527
2018	Circuit1916	15	15	15	15	13	15	15	14
2018	Circuit1917	-	-	-	-	-	0	0	-
2018	Circuit1918	590	590	587	589	589	596	601	595
2018	Circuit1919	506	506	506	506	504	506	508	506
2018	Circuit1920	-	-	-	-	-	0	0	-
2018	Circuit1921	1,062	1,062	1,072	1,065	1,073	1075	1075	1,074
2018	Circuit1922	1,156	1,156	1,165	1,159	1,166	1174	886	1,075
2018	Circuit1923	4	4	4	4	-	0	0	-
2018	Circuit1924	655	655	656	655	652	656	654	654
2018	Circuit1925	835	835	841	837	837	843	840	840
2018	Circuit1926	19	19	19	19	16	22	26	21
2018	Circuit1009	751	751	753	752	751	752	753	752
2018	Circuit1010	736	736	736	736	734	548	499	594
2018	Circuit1011	418	418	418	418	413	421	418	417
2018	Circuit1012	422	422	422	422	422	427	428	426
2018	Circuit1013	550	550	550	550	550	553	551	551
2018	Circuit1014	691	691	688	690	685	659	661	668
2018	Circuit1016	624	624	624	624	622	626	625	624
2018	Circuit1017	612	612	611	612	607	616	615	613
2018	Circuit1018	432	432	432	432	429	381	432	414
2018	Circuit1019	1,038	1,038	1,035	1,037	1,032	1035	1030	1,032
2018	Circuit1022	1,051	1,051	1,055	1,052	1,058	1056	1056	1,057
2018	Circuit1023	327	327	326	327	322	328	327	326
2018	Circuit3760	-	-	-	-	-	-	-	-
2018	Circuit3732	-	-	-	-	-	-	-	-
2018	Circuit1927	81	81	81	81	72	78	79	76
2018	Circuit1928	404	404	408	405	407	413	415	412
2018	Circuit1936	5	5	4	5	3	4	5	4
2018	Circuit1938	3	3	3	3	2	4	4	3
2018	Circuit1939	474	474	463	470	461	484	501	482
2018	Circuit1940	747	747	715	736	732	789	884	802
2018	Circuit1941	646	646	670	654	671	709	723	701
2018	Circuit1024	55	55	54	55	52	50	52	51

Michigan Public Service Commission

DTE Electric Company

Discovery Response: U-21534 MNSCDE-3.6-01

4.8kV Hardening Data

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1026	277	277	276	277	278	283	286	282
2018	Circuit1028	174	174	176	175	178	181	180	180
2018	Circuit1029	47	47	50	48	50	53	51	51
2018	Circuit1030	220	220	220	220	220	233	233	229
2018	Circuit1031	1	1	1	1	2	2	2	2
2018	Circuit1032	106	106	109	107	109	109	111	110
2018	Circuit1033	123	123	127	124	126	216	217	186
2018	Circuit1034	30	30	30	30	27	82	90	66
2018	Circuit3725	-	-	-	-	-	-	-	-
2018	Circuit3726	-	-	-	-	-	-	-	-
2018	Circuit1038	526	526	493	515	502	538	535	525
2018	Circuit1037	-	-	-	-	-	0	0	-
2018	Circuit3746	-	-	-	-	-	-	-	-
2018	Circuit3729	-	-	-	-	-	-	-	-
2018	Circuit3484	81	81	79	80	78	80	88	82
2018	Circuit4113	-	-	-	-	-	-	-	-
2018	Circuit3722	41	41	-	27	-	-	-	-
2018	Circuit3486	43	43	43	43	41	49	50	47
2018	Circuit3487	78	78	80	79	76	78	83	79
2018	Circuit3488	-	-	39	13	37	40	40	39
2018	Circuit3489	-	-	885	295	889	892	898	893
2018	Circuit3490	-	-	760	253	769	778	779	775
2018	Circuit3690	762	762	-	508	-	-	-	-
2018	Circuit3491	948	948	948	948	948	1013	1013	991
2018	Circuit3492	462	462	460	461	454	457	456	456
2018	Circuit3493	809	809	808	809	809	820	819	816
2018	Circuit3494	-	-	-	-	-	0	0	-
2018	Circuit3759	-	-	-	-	-	-	-	-
2018	Circuit3495	616	616	614	615	611	615	615	614
2018	Circuit3496	664	664	615	648	608	639	643	630
2018	Circuit3497	789	789	788	789	788	789	797	791
2018	Circuit3498	503	503	501	502	498	496	504	499
2018	Circuit3499	911	911	913	912	915	916	915	915
2018	Circuit3501	992	992	996	993	993	1010	1012	1,005
2018	Circuit3502	1,570	1,570	1,591	1,577	1,586	1149	1153	1,296
2018	Circuit3503	716	716	718	717	716	736	733	728
2018	Circuit3509	688	688	689	688	683	705	720	703
2018	Circuit3510	987	987	1,013	996	1,008	1020	1020	1,016
2018	Circuit3511	384	384	385	384	378	853	848	693
2018	Circuit3513	217	217	213	216	212	274	269	252
2018	Circuit3723	-	-	-	-	-	-	-	-
2018	Circuit3684	-	-	-	-	-	0	0	-
2018	Circuit3685	-	-	-	-	-	0	0	-
2018	Circuit3535	-	-	-	-	-	0	0	-
2018	Circuit3686	-	38	-	13	-	0	0	-
2018	Circuit3536	2	2	1	2	1	2	2	2
2018	Circuit3687	-	-	-	-	-	0	0	-
2018	Circuit3537	31	31	29	30	25	31	29	28
2018	Circuit4114	-	-	-	-	-	-	-	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3688	1	1	1	1	1	0	0	0
2018	Circuit3619	1,110	1,110	1,115	1,112	1,128	0	0	376
2018	Circuit3621	1,196	1,196	1,182	1,191	1,195	0	0	398
2018	Circuit1047	-	-	591	197	648	646	655	650
2018	Circuit1048	-	804	-	268	829	864	875	856
2018	Circuit1049	-	-	-	-	1,102	1128	1134	1,121
2018	Circuit2377	-	-	-	-	-	1956	1977	1,311
2018	Circuit2378	-	-	-	-	-	1680	1724	1,135
2019	Circuit3715	-	-	-	-	-	-	-	-
2019	Circuit3720	-	-	-	-	-	-	-	-
2019	Circuit206	568	568	566	567	569	559	559	562
2019	Circuit208	859	857	856	857	861	857	857	858
2019	Circuit211	1,386	1,385	1,387	1,386	1,400	1400	1400	1,400
2019	Circuit2434	652	652	654	653	654	656	656	655
2019	Circuit2436	804	807	808	806	809	806	806	807
2019	Circuit2438	154	154	146	151	197	197	197	197
2019	Circuit2439	709	712	714	712	718	718	718	718
2019	Circuit3624	-	-	-	-	-	0	0	-
2019	Circuit2441	69	67	65	67	57	57	57	57
2019	Circuit2442	979	981	985	982	988	987	987	987
2019	Circuit2443	641	645	648	645	678	677	677	677
2019	Circuit2444	706	704	701	704	703	705	705	704
2019	Circuit2445	627	627	632	629	632	632	632	632
2019	Circuit2446	780	760	762	767	785	785	785	785
2019	Circuit2447	1,044	1,042	1,042	1,043	1,044	1042	1042	1,043
2019	Circuit4037	-	-	-	-	-	-	-	-
2019	Circuit4038	-	-	-	-	-	-	-	-
2019	Circuit4039	-	-	-	-	-	-	-	-
2019	Circuit4040	-	-	-	-	-	-	-	-
2019	Circuit4041	-	-	-	-	-	-	-	-
2019	Circuit4042	-	-	-	-	-	-	-	-
2019	Circuit4043	-	-	-	-	-	-	-	-
2019	Circuit3625	-	-	-	-	-	0	0	-
2019	Circuit2455	91	88	85	88	89	91	91	90
2019	Circuit2460	280	281	278	280	282	284	284	283
2019	Circuit2466	3	3	3	3	7	8	8	8
2019	Circuit2472	136	108	103	116	108	111	111	110
2019	Circuit2473	743	759	762	755	795	798	798	797
2019	Circuit2474	734	680	680	698	808	811	811	810
2019	Circuit1595	-	-	-	-	-	0	0	-
2019	Circuit1596	23	23	19	22	32	33	33	33
2019	Circuit1597	119	126	121	122	125	125	125	125
2019	Circuit1598	908	918	951	926	1,021	1036	1036	1,031
2019	Circuit1599	616	619	615	617	711	714	714	713
2019	Circuit1600	911	892	909	904	943	949	949	947
2019	Circuit1601	854	853	859	855	716	721	721	719
2019	Circuit1602	539	551	555	548	563	564	564	564
2019	Circuit1603	698	700	700	699	720	722	722	721
2019	Circuit1604	748	742	749	746	788	809	809	802

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1605	901	898	930	910	996	1000	1000	999
2019	Circuit1606	769	770	769	769	670	670	672	671
2019	Circuit1607	787	794	802	794	773	800	800	791
2019	Circuit3741	-	-	-	-	-	-	-	-
2019	Circuit4095	-	-	-	-	-	-	-	-
2019	Circuit2015	85	85	85	85	88	87	87	87
2019	Circuit2016	587	584	585	585	574	578	578	577
2019	Circuit2017	596	595	592	594	608	611	611	610
2019	Circuit2527	-	-	-	-	-	0	0	-
2019	Circuit4096	-	-	-	-	-	-	-	-
2019	Circuit2019	24	26	26	25	28	28	28	28
2019	Circuit2020	190	188	185	188	193	194	194	194
2019	Circuit2021	-	-	-	-	-	0	0	-
2019	Circuit2022	795	805	809	803	743	745	745	744
2019	Circuit2023	803	803	804	803	808	1058	1058	975
2019	Circuit2024	440	441	441	441	445	445	445	445
2019	Circuit2025	608	607	602	606	1,569	1568	1568	1,568
2019	Circuit1628	-	-	-	-	-	0	0	-
2019	Circuit3728	-	-	-	-	-	-	-	-
2019	Circuit1629	695	692	693	693	696	694	694	695
2019	Circuit1630	893	894	897	895	899	900	900	900
2019	Circuit1631	583	583	583	583	583	584	584	584
2019	Circuit1632	624	625	626	625	627	631	631	630
2019	Circuit1633	1,124	1,121	1,110	1,118	1,135	1136	1136	1,136
2019	Circuit2559	644	643	640	642	647	647	647	647
2019	Circuit1634	385	385	386	385	384	383	383	383
2019	Circuit2566	161	158	155	158	160	161	161	161
2019	Circuit2578	1,280	1,279	1,289	1,283	1,288	1288	1288	1,288
2019	Circuit2579	733	737	740	737	739	741	741	740
2019	Circuit3730	-	-	-	-	-	-	-	-
2019	Circuit1237	182	181	177	180	181	179	179	180
2019	Circuit1238	1	1	-	1	1	1	1	1
2019	Circuit1239	328	326	327	327	327	328	328	328
2019	Circuit1240	267	269	268	268	266	265	265	265
2019	Circuit1241	-	-	-	-	-	0	0	-
2019	Circuit1242	362	361	359	361	361	362	362	362
2019	Circuit1243	471	459	487	472	488	466	466	473
2019	Circuit1244	639	634	628	634	635	635	635	635
2019	Circuit1245	555	554	557	555	558	558	558	558
2019	Circuit1246	432	430	433	432	348	345	345	346
2019	Circuit3710	-	-	-	-	-	-	-	-
2019	Circuit820	12	12	11	12	12	11	11	11
2019	Circuit825	5	7	5	6	6	7	7	7
2019	Circuit826	83	84	84	84	88	89	89	89
2019	Circuit827	68	83	79	77	109	116	116	114
2019	Circuit828	790	790	792	791	864	902	902	889
2019	Circuit829	1,029	992	1,028	1,016	1,118	1124	1124	1,122
2019	Circuit830	764	739	765	756	836	835	835	835
2019	Circuit831	37	35	33	35	34	34	34	34

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit832	629	626	664	640	715	730	730	725
2019	Circuit833	404	372	394	390	426	454	454	445
2019	Circuit834	242	229	226	232	245	255	255	252
2019	Circuit835	637	603	616	619	643	675	675	664
2019	Circuit836	690	640	670	667	708	734	734	725
2019	Circuit837	251	245	237	244	253	256	256	255
2019	Circuit838	786	677	727	730	731	785	785	767
2019	Circuit2666	-	-	-	-	-	-	-	-
2019	Circuit4093	-	-	-	-	-	-	-	-
2019	Circuit3638	1	-	-	0	-	0	0	-
2019	Circuit4097	-	-	-	-	-	-	-	-
2019	Circuit3639	-	1	-	0	-	0	0	-
2019	Circuit4098	-	-	-	-	-	-	-	-
2019	Circuit3578	538	532	-	357	-	0	0	-
2019	Circuit2679	-	-	-	-	30	30	30	30
2019	Circuit2681	-	-	-	-	950	1057	1057	1,021
2019	Circuit3736	-	-	-	-	-	-	-	-
2019	Circuit3733	-	-	-	-	-	-	-	-
2019	Circuit1663	310	307	302	306	309	311	311	310
2019	Circuit1664	713	719	717	716	721	724	724	723
2019	Circuit1665	515	517	518	517	520	519	519	519
2019	Circuit1666	1,321	1,329	1,327	1,326	1,336	1101	1101	1,179
2019	Circuit1668	802	790	793	795	799	798	798	798
2019	Circuit1669	992	991	992	992	1,051	972	972	998
2019	Circuit852	622	535	534	564	540	548	548	545
2019	Circuit853	666	669	661	665	669	683	683	678
2019	Circuit854	942	932	978	951	1,007	1019	1019	1,015
2019	Circuit856	-	-	-	-	-	0	0	-
2019	Circuit858	91	90	88	90	91	91	91	91
2019	Circuit859	320	318	314	317	374	364	364	367
2019	Circuit3743	-	-	-	-	-	-	-	-
2019	Circuit861	1,032	1,029	1,031	1,031	1,034	932	932	966
2019	Circuit862	583	583	581	582	582	583	583	583
2019	Circuit863	416	785	780	660	737	747	747	744
2019	Circuit864	661	338	335	445	340	338	338	339
2019	Circuit3742	-	-	-	-	-	-	-	-
2019	Circuit3739	-	-	-	-	-	-	-	-
2019	Circuit3711	-	-	-	-	-	-	-	-
2019	Circuit3751	-	-	-	-	-	-	-	-
2019	Circuit1684	523	527	527	526	529	527	527	528
2019	Circuit1685	1,037	1,039	1,037	1,038	1,041	1041	1041	1,041
2019	Circuit1686	1,290	1,287	1,299	1,292	1,295	1297	1297	1,296
2019	Circuit1687	779	779	779	779	784	787	787	786
2019	Circuit1688	1,413	1,420	1,427	1,420	1,424	1421	1421	1,422
2019	Circuit2729	4	4	3	4	5	5	5	5
2019	Circuit2730	7	8	4	6	6	7	7	7
2019	Circuit2731	-	-	-	-	-	0	0	-
2019	Circuit2732	3	3	3	3	4	5	5	5
2019	Circuit2733	56	57	52	55	61	61	61	61

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit2734	451	457	458	455	337	340	340	339
2019	Circuit2737	1,045	1,033	1,055	1,044	1,064	1063	1063	1,063
2019	Circuit2738	372	375	381	376	509	516	516	514
2019	Circuit2739	933	932	936	934	936	938	938	937
2019	Circuit2740	1,161	1,169	1,175	1,168	1,175	1174	1174	1,174
2019	Circuit2741	650	644	666	653	674	676	676	675
2019	Circuit2742	1,336	1,335	1,378	1,350	1,467	1460	1460	1,462
2019	Circuit2744	775	785	793	784	803	804	804	804
2019	Circuit2745	820	818	819	819	822	822	822	822
2019	Circuit2746	976	975	977	976	977	982	982	980
2019	Circuit2752	-	1,109	1,107	739	1,113	1110	1110	1,111
2019	Circuit2753	833	832	836	834	839	843	843	842
2019	Circuit2754	858	865	866	863	872	870	870	871
2019	Circuit2755	597	603	601	600	605	607	607	606
2019	Circuit2756	323	323	327	324	327	328	328	328
2019	Circuit4087	-	-	-	-	-	-	-	-
2019	Circuit875	657	652	658	656	667	666	666	666
2019	Circuit876	1,129	1,127	1,155	1,137	1,184	1191	1191	1,189
2019	Circuit4099	-	-	-	-	-	-	-	-
2019	Circuit4100	-	-	-	-	-	-	-	-
2019	Circuit3712	1,110	-	-	370	-	-	-	-
2019	Circuit3716	-	-	-	-	-	-	-	-
2019	Circuit3641	-	-	-	-	-	0	0	-
2019	Circuit3642	-	-	-	-	-	-	-	-
2019	Circuit3587	686	678	661	675	-	0	0	-
2019	Circuit1701	1,008	1,010	999	1,006	-	0	0	-
2019	Circuit3588	1,205	1,206	1,203	1,205	-	0	0	-
2019	Circuit2058	-	-	-	-	-	0	0	-
2019	Circuit2060	647	647	647	647	648	646	646	647
2019	Circuit4088	-	-	-	-	-	-	-	-
2019	Circuit2790	478	478	471	476	487	488	488	488
2019	Circuit2791	675	673	673	674	834	675	675	728
2019	Circuit2792	496	491	495	494	502	501	501	501
2019	Circuit3750	-	-	-	-	-	-	-	-
2019	Circuit2794	397	397	393	396	405	410	410	408
2019	Circuit3754	-	-	-	-	-	-	-	-
2019	Circuit2795	-	-	-	-	1	1	1	1
2019	Circuit2807	756	757	754	756	756	762	762	760
2019	Circuit2808	659	657	656	657	667	659	659	662
2019	Circuit879	17	17	13	16	15	16	16	16
2019	Circuit880	-	-	-	-	1	1	1	1
2019	Circuit881	1	1	1	1	1	1	1	1
2019	Circuit882	29	31	27	29	28	29	29	29
2019	Circuit883	140	140	142	141	146	146	146	146
2019	Circuit884	34	29	20	28	30	29	29	29
2019	Circuit886	10	10	8	9	11	11	11	11
2019	Circuit887	266	269	280	272	496	511	511	506
2019	Circuit888	379	336	332	349	406	447	447	433
2019	Circuit889	945	1,006	1,038	996	1,482	1526	1526	1,511

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit892	840	852	843	845	702	706	706	705
2019	Circuit893	135	132	131	133	132	143	143	139
2019	Circuit2063	336	335	333	335	342	329	329	333
2019	Circuit3745	-	-	-	-	-	-	-	-
2019	Circuit3755	-	-	-	-	-	-	-	-
2019	Circuit3718	-	-	-	-	-	-	-	-
2019	Circuit2066	-	-	-	-	-	0	0	-
2019	Circuit2067	187	219	209	205	215	218	218	217
2019	Circuit2068	1,038	1,010	1,005	1,018	1,019	1022	1022	1,021
2019	Circuit2069	861	678	675	738	679	676	676	677
2019	Circuit2070	940	864	866	890	723	721	721	722
2019	Circuit2071	821	593	595	670	599	600	600	600
2019	Circuit2072	438	437	434	436	448	448	448	448
2019	Circuit3740	-	-	-	-	-	-	-	-
2019	Circuit895	7	7	5	6	5	5	5	5
2019	Circuit3622	-	-	-	-	-	-	-	-
2019	Circuit3643	5	-	-	2	-	0	0	-
2019	Circuit896	4	4	3	4	4	4	4	4
2019	Circuit3623	131	132	132	132	-	-	-	-
2019	Circuit4101	-	-	-	-	-	-	-	-
2019	Circuit897	190	191	191	191	195	192	192	193
2019	Circuit898	-	-	-	-	-	0	0	-
2019	Circuit901	111	114	110	112	112	113	113	113
2019	Circuit903	195	187	187	190	189	191	191	190
2019	Circuit904	369	357	350	359	322	331	331	328
2019	Circuit3734	-	-	-	-	-	-	-	-
2019	Circuit1708	1,035	1,050	1,091	1,059	1,144	1135	1135	1,138
2019	Circuit1709	706	712	733	717	742	743	743	743
2019	Circuit1712	676	680	682	679	682	682	682	682
2019	Circuit4102	-	-	-	-	-	-	-	-
2019	Circuit4103	-	-	-	-	-	-	-	-
2019	Circuit2083	783	785	785	784	761	784	784	776
2019	Circuit2084	583	582	583	583	579	578	578	578
2019	Circuit2085	780	781	788	783	790	792	792	791
2019	Circuit2086	-	-	-	-	-	0	0	-
2019	Circuit3731	-	-	-	-	-	-	-	-
2019	Circuit2087	381	389	392	387	716	720	720	719
2019	Circuit2088	1,664	1,680	1,684	1,676	1,666	1663	1663	1,664
2019	Circuit3744	-	-	-	-	-	-	-	-
2019	Circuit1716	-	-	-	-	-	0	0	-
2019	Circuit1717	20	22	18	20	26	26	26	26
2019	Circuit1719	3	3	1	2	4	4	4	4
2019	Circuit1721	4	4	3	4	3	3	3	3
2019	Circuit1726	-	-	-	-	-	0	0	-
2019	Circuit4104	-	-	-	-	-	-	-	-
2019	Circuit1727	36	40	25	34	28	28	28	28
2019	Circuit1728	102	102	99	101	103	100	100	101
2019	Circuit1729	11	11	34	19	38	38	38	38
2019	Circuit1730	17	18	14	16	18	17	17	17

4.8kV Hardening Data		Customer Count Control Group								
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg	
2019	Circuit1732	1,046	922	1,043	1,004	1,091	1098	1098	1,096	
2019	Circuit1733	767	768	772	769	774	772	772	773	
2019	Circuit1734	940	946	944	943	887	944	944	925	
2019	Circuit1735	871	873	871	872	1,018	1017	1017	1,017	
2019	Circuit1736	778	781	783	781	783	783	783	783	
2019	Circuit1737	991	995	979	988	982	982	982	982	
2019	Circuit1738	1,273	1,283	1,288	1,281	1,477	1473	1473	1,474	
2019	Circuit1739	818	825	828	824	844	845	845	845	
2019	Circuit4094	-	-	-	-	-	-	-	-	
2019	Circuit2859	680	679	682	680	695	683	683	687	
2019	Circuit1401	361	371	371	368	383	384	384	384	
2019	Circuit1402	679	678	679	679	685	684	684	684	
2019	Circuit3738	-	-	-	-	-	-	-	-	
2019	Circuit4105	-	-	-	-	-	-	-	-	
2019	Circuit3644	1	1	-	1	2	0	0	1	
2019	Circuit3756	-	-	-	-	-	-	-	-	
2019	Circuit2862	21	21	16	19	20	20	20	20	
2019	Circuit2863	32	30	29	30	34	100	100	78	
2019	Circuit2864	197	202	202	200	215	212	212	213	
2019	Circuit2865	737	737	737	737	743	746	746	745	
2019	Circuit2866	806	809	804	806	817	817	817	817	
2019	Circuit2867	-	-	-	-	-	0	0	-	
2019	Circuit2869	538	541	542	540	543	540	540	541	
2019	Circuit2870	1,356	1,367	1,372	1,365	1,377	1378	1378	1,378	
2019	Circuit2877	877	871	875	874	1,200	879	879	986	
2019	Circuit2878	-	-	-	-	-	0	0	-	
2019	Circuit2879	516	514	517	516	1,100	516	516	711	
2019	Circuit2881	1,203	1,196	1,203	1,201	118	1203	1203	841	
2019	Circuit2882	310	310	310	310	450	316	316	361	
2019	Circuit2884	891	890	894	892	243	903	903	683	
2019	Circuit2885	1,747	1,741	1,743	1,744	11	1748	1748	1,169	
2019	Circuit2886	686	683	684	684	673	684	684	680	
2019	Circuit2887	534	534	536	535	1,321	539	539	800	
2019	Circuit2888	944	962	967	958	4,027	1062	1062	2,050	
2019	Circuit2889	836	836	840	837	850	846	846	847	
2019	Circuit2890	762	760	761	761	1,497	764	764	1,008	
2019	Circuit2895	634	636	629	633	634	634	634	634	
2019	Circuit1744	-	-	-	-	-	0	0	-	
2019	Circuit3727	-	-	-	-	-	-	-	-	
2019	Circuit3719	-	-	-	-	-	-	-	-	
2019	Circuit3590	18	18	16	17	-	0	0	-	
2019	Circuit3591	61	60	56	59	-	0	0	-	
2019	Circuit3592	794	715	750	753	-	0	0	-	
2019	Circuit3594	544	516	514	525	-	0	0	-	
2019	Circuit3595	1,090	1,096	1,083	1,090	-	0	0	-	
2019	Circuit1752	325	327	326	326	327	326	326	326	
2019	Circuit1753	506	508	507	507	518	518	518	518	
2019	Circuit1759	691	689	692	691	691	692	692	692	
2019	Circuit1754	545	543	545	544	545	549	549	548	

4.8KV Hardening Data		Customer Count Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1755	409	409	408	409	408	409	409	409
2019	Circuit1756	548	546	547	547	544	548	548	547
2019	Circuit4106	-	-	-	-	-	-	-	-
2019	Circuit3646	1	-	-	0	-	0	0	-
2019	Circuit2931	-	-	-	-	-	0	0	-
2019	Circuit2932	390	394	409	398	399	420	420	413
2019	Circuit2933	750	756	756	754	753	751	751	752
2019	Circuit2934	1,095	1,108	1,125	1,109	1,144	1152	1152	1,149
2019	Circuit2935	1,024	1,041	1,062	1,042	1,083	1096	1096	1,092
2019	Circuit2936	116	112	109	112	117	116	116	116
2019	Circuit2937	299	312	315	309	315	319	319	318
2019	Circuit1764	-	-	-	-	-	0	0	-
2019	Circuit1765	-	-	-	-	-	0	0	-
2019	Circuit1250	20	16	15	17	17	17	17	17
2019	Circuit1252	331	329	329	330	364	364	364	364
2019	Circuit1253	1,065	1,059	1,071	1,065	1,082	1087	1087	1,085
2019	Circuit1255	941	930	936	936	944	953	953	950
2019	Circuit1256	1,348	1,341	899	1,196	904	1330	1330	1,188
2019	Circuit1257	176	154	157	162	153	149	149	150
2019	Circuit944	358	468	477	434	529	527	527	528
2019	Circuit945	27	28	23	26	28	27	27	27
2019	Circuit946	281	283	271	278	448	636	636	573
2019	Circuit947	172	169	162	168	221	224	224	223
2019	Circuit3649	2	2	1	2	-	0	0	-
2019	Circuit3650	-	-	-	-	-	0	0	-
2019	Circuit3651	-	-	-	-	-	0	0	-
2019	Circuit1766	445	497	491	478	508	507	507	507
2019	Circuit1768	432	433	425	430	437	437	437	437
2019	Circuit1769	658	657	651	655	659	659	659	659
2019	Circuit1771	8	8	4	7	12	13	13	13
2019	Circuit1772	368	368	365	367	372	372	372	372
2019	Circuit1773	833	767	781	794	831	831	831	831
2019	Circuit1774	552	551	549	551	677	678	678	678
2019	Circuit948	-	-	-	-	1	1	1	1
2019	Circuit950	291	280	283	285	284	306	306	299
2019	Circuit951	414	389	403	402	441	422	422	428
2019	Circuit952	531	523	532	529	543	557	557	552
2019	Circuit953	483	453	464	467	467	483	483	478
2019	Circuit954	604	591	597	597	598	611	611	607
2019	Circuit955	387	365	369	374	368	385	385	379
2019	Circuit4089	-	-	-	-	-	-	-	-
2019	Circuit2992	-	-	-	-	-	0	0	-
2019	Circuit2993	23	24	20	22	23	21	21	22
2019	Circuit2994	51	51	22	41	22	49	49	40
2019	Circuit2995	868	855	865	863	871	877	877	875
2019	Circuit2996	678	678	682	679	683	685	685	684
2019	Circuit2997	467	465	467	466	471	470	470	470
2019	Circuit2998	980	983	983	982	991	994	994	993
2019	Circuit2999	723	724	724	724	721	722	722	722

Year	Circuit	Customer Count Control Group						
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after
2019	Circuit3737	-	-	-	-	-	-	-
2019	Circuit959	-	-	-	-	-	0	0
2019	Circuit3656	-	-	-	-	-	0	0
2019	Circuit4107	-	-	-	-	-	-	-
2019	Circuit3598	74	-	-	25	-	0	0
2019	Circuit3041	547	553	559	553	563	566	566
2019	Circuit3049	-	-	-	-	-	-	-
2019	Circuit3050	-	-	-	-	-	-	-
2019	Circuit3051	-	-	-	-	-	-	-
2019	Circuit3052	-	-	-	-	-	-	-
2019	Circuit3056	100	100	94	98	105	111	111
2019	Circuit3064	406	406	403	405	411	355	355
2019	Circuit3065	906	906	900	904	920	907	907
2019	Circuit3066	880	855	857	864	855	856	856
2019	Circuit3068	-	1	-	0	1	1	1
2019	Circuit3069	12	12	8	11	13	12	12
2019	Circuit1779	810	807	800	806	766	757	757
2019	Circuit3070	534	535	532	534	538	526	526
2019	Circuit3071	645	642	639	642	645	653	653
2019	Circuit3072	290	289	287	289	1,115	1121	1121
2019	Circuit3073	554	550	548	551	560	610	610
2019	Circuit3074	670	669	669	669	904	906	906
2019	Circuit1780	37	37	33	36	362	384	384
2019	Circuit1781	3	-	-	1	-	0	0
2019	Circuit1782	21	22	21	21	20	22	22
2019	Circuit1783	17	17	17	17	17	18	18
2019	Circuit4108	-	-	-	-	-	-	-
2019	Circuit1785	43	40	35	39	40	39	39
2019	Circuit1786	1	-	-	0	1	1	1
2019	Circuit1788	7	7	7	7	8	9	9
2019	Circuit1789	712	708	709	710	730	714	714
2019	Circuit1790	728	719	713	720	412	411	411
2019	Circuit1791	649	644	640	644	670	668	668
2019	Circuit1792	1,385	1,367	1,374	1,375	1,434	1439	1439
2019	Circuit1793	485	483	477	482	469	468	468
2019	Circuit1794	878	896	902	892	942	935	935
2019	Circuit1795	208	211	204	208	241	239	239
2019	Circuit4109	-	-	-	-	-	-	-
2019	Circuit3657	14	52	-	22	-	0	0
2019	Circuit3658	2	-	-	1	-	0	0
2019	Circuit3606	-	27	29	19	-	0	0
2019	Circuit3607	110	8	2	40	-	0	0
2019	Circuit3608	56	2	1	20	-	0	0
2019	Circuit3609	14	5	4	8	-	0	0
2019	Circuit3659	-	-	-	-	-	0	0
2019	Circuit3660	-	-	-	-	-	0	0
2019	Circuit3661	3	3	3	3	-	0	0
2019	Circuit3713	1,074	-	-	358	-	-	-
2019	Circuit3662	-	-	-	-	-	0	0

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3663	52	49	48	50	-	0	0	-
2019	Circuit3611	177	151	157	162	-	0	0	-
2019	Circuit3714	653	-	-	218	-	-	-	-
2019	Circuit3094	-	-	-	-	-	0	0	-
2019	Circuit3096	34	35	31	33	37	36	36	36
2019	Circuit3097	1,183	1,189	1,198	1,190	1,204	1198	1198	1,200
2019	Circuit3099	1,018	1,014	1,018	1,017	1,023	1023	1023	1,023
2019	Circuit3747	-	-	-	-	-	-	-	-
2019	Circuit3100	617	622	622	620	627	626	626	626
2019	Circuit3101	1,195	1,195	1,202	1,197	1,203	1242	1242	1,229
2019	Circuit3102	881	878	879	879	886	886	886	886
2019	Circuit3758	-	-	-	-	-	-	-	-
2019	Circuit1798	772	759	785	772	860	885	885	877
2019	Circuit1799	1,058	1,037	1,066	1,054	1,177	1213	1213	1,201
2019	Circuit1800	661	641	674	659	729	766	766	754
2019	Circuit1801	785	802	829	805	911	938	938	929
2019	Circuit1802	740	737	767	748	841	883	883	869
2019	Circuit1803	29	27	27	28	33	35	35	34
2019	Circuit1804	554	532	549	545	596	623	623	614
2019	Circuit1805	22	22	17	20	22	22	22	22
2019	Circuit1808	-	-	-	-	-	0	0	-
2019	Circuit1423	-	-	-	-	-	0	0	-
2019	Circuit3124	37	37	36	37	37	38	38	38
2019	Circuit3126	23	25	20	23	28	28	28	28
2019	Circuit3127	-	-	-	-	-	0	0	-
2019	Circuit3128	-	-	-	-	-	0	0	-
2019	Circuit3665	-	-	-	-	-	0	0	-
2019	Circuit3131	853	859	877	863	927	946	946	940
2019	Circuit3748	-	-	-	-	-	-	-	-
2019	Circuit4090	-	-	-	-	-	-	-	-
2019	Circuit1812	64	65	59	63	62	65	65	64
2019	Circuit1815	23	26	24	24	25	24	24	24
2019	Circuit1816	2	2	2	2	2	2	2	2
2019	Circuit3666	-	-	-	-	-	-	-	-
2019	Circuit1817	2	1	1	1	2	2	2	2
2019	Circuit3667	13	-	-	4	-	0	0	-
2019	Circuit1818	11	11	9	10	11	11	11	11
2019	Circuit1819	38	39	30	36	38	39	39	39
2019	Circuit1820	431	431	444	435	468	483	483	478
2019	Circuit1821	812	811	797	807	803	807	807	806
2019	Circuit1822	81	73	66	73	69	71	71	70
2019	Circuit1823	1,313	1,322	1,326	1,320	1,336	1334	1334	1,335
2019	Circuit1824	1,166	1,205	1,219	1,197	1,263	1288	1288	1,280
2019	Circuit1825	1,195	1,208	1,209	1,204	1,214	1214	1214	1,214
2019	Circuit1826	805	808	809	807	815	814	814	814
2019	Circuit3156	-	1	-	0	5	8	8	7
2019	Circuit3668	-	-	-	-	-	-	-	-
2019	Circuit1269	-	-	-	-	-	0	0	-
2019	Circuit1270	-	-	-	-	-	0	0	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1827	499	502	498	500	501	503	503	502
2019	Circuit1828	572	574	577	574	578	578	578	578
2019	Circuit1829	249	251	249	250	250	252	252	251
2019	Circuit1830	694	687	689	690	692	689	689	690
2019	Circuit3184	73	73	72	73	91	75	75	80
2019	Circuit3185	1,673	1,667	1,677	1,672	1,686	1636	1636	1,653
2019	Circuit3186	724	720	722	722	704	723	723	717
2019	Circuit3187	712	713	713	713	717	720	720	719
2019	Circuit3188	388	388	388	388	395	448	448	430
2019	Circuit3189	-	-	-	-	-	0	0	-
2019	Circuit3190	539	538	538	538	543	512	512	522
2019	Circuit3192	1,125	1,121	1,125	1,124	1,130	1128	1128	1,129
2019	Circuit3193	459	451	450	453	470	78	78	209
2019	Circuit3753	-	-	-	-	-	-	-	-
2019	Circuit3194	1,022	1,021	1,020	1,021	1,032	1030	1030	1,031
2019	Circuit3669	-	-	-	-	-	0	0	-
2019	Circuit3195	1,187	1,182	1,194	1,188	1,201	1199	1199	1,200
2019	Circuit1839	518	509	489	505	530	532	532	531
2019	Circuit1845	416	415	417	416	420	419	419	419
2019	Circuit1846	220	217	220	219	220	220	220	220
2019	Circuit1847	302	301	310	304	317	317	317	317
2019	Circuit1848	670	670	681	674	770	766	766	767
2019	Circuit1849	269	267	266	267	275	280	280	278
2019	Circuit1850	11	11	9	10	13	10	10	11
2019	Circuit1851	231	229	225	228	235	235	235	235
2019	Circuit1852	21	20	17	19	14	13	13	13
2019	Circuit1853	147	149	150	149	414	416	416	415
2019	Circuit1854	380	391	380	384	123	125	125	124
2019	Circuit3752	-	-	-	-	-	-	-	-
2019	Circuit4110	-	-	-	-	-	-	-	-
2019	Circuit1433	279	279	275	278	276	279	279	278
2019	Circuit1434	433	433	433	433	446	444	444	445
2019	Circuit2145	236	235	232	234	235	236	236	236
2019	Circuit2146	698	693	692	694	698	704	704	702
2019	Circuit3253	-	-	-	-	-	0	0	-
2019	Circuit2147	361	361	359	360	360	359	359	359
2019	Circuit1438	-	-	-	-	-	0	0	-
2019	Circuit4091	-	-	-	-	-	-	-	-
2019	Circuit3749	-	-	-	-	-	-	-	-
2019	Circuit1298	453	448	454	452	455	456	456	456
2019	Circuit3717	-	-	-	-	-	-	-	-
2019	Circuit3735	-	-	-	-	-	-	-	-
2019	Circuit979	-	-	-	-	-	0	0	-
2019	Circuit980	-	-	-	-	-	0	0	-
2019	Circuit3677	8	-	-	3	-	0	0	-
2019	Circuit981	1	1	-	1	1	1	1	1
2019	Circuit3302	-	-	-	-	-	0	0	-
2019	Circuit3303	-	-	-	-	-	0	0	-
2019	Circuit1877	1	1	-	1	2	2	2	2

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1878	1,444	1,443	1,418	1,435	1,188	1041	1041	1,090
2019	Circuit1879	23	23	18	21	24	25	25	25
2019	Circuit1880	823	836	832	830	844	892	892	876
2019	Circuit2150	789	795	795	793	794	904	904	867
2019	Circuit3721	-	-	-	-	-	-	-	-
2019	Circuit3314	40	40	36	39	37	38	38	38
2019	Circuit3315	-	-	-	-	-	0	0	-
2019	Circuit3316	349	347	348	348	420	344	344	369
2019	Circuit3317	630	632	651	638	1,249	637	637	841
2019	Circuit3318	389	383	384	385	390	392	392	391
2019	Circuit3319	634	635	633	634	635	614	614	621
2019	Circuit3320	1,020	1,021	1,029	1,023	1,031	1031	1031	1,031
2019	Circuit3321	837	840	840	839	857	859	859	858
2019	Circuit3322	407	405	406	406	412	410	410	411
2019	Circuit3323	618	617	616	617	389	620	620	543
2019	Circuit3324	675	678	680	678	682	934	934	850
2019	Circuit3757	-	-	-	-	-	-	-	-
2019	Circuit3353	-	-	-	-	-	-	-	-
2019	Circuit2167	845	844	842	844	846	846	846	846
2019	Circuit2165	562	563	562	562	564	565	565	565
2019	Circuit2166	652	654	647	651	736	735	735	735
2019	Circuit1314	-	-	-	-	-	0	0	-
2019	Circuit3395	891	878	895	888	998	1055	1055	1,036
2019	Circuit4111	-	-	-	-	-	-	-	-
2019	Circuit3397	376	375	375	375	499	384	384	422
2019	Circuit3398	545	542	525	537	508	539	539	529
2019	Circuit3399	3	3	2	3	4	4	4	4
2019	Circuit3400	760	755	756	757	1,803	767	767	1,112
2019	Circuit1461	1	1	1	1	-	0	0	-
2019	Circuit3724	-	-	-	-	-	-	-	-
2019	Circuit4112	-	-	-	-	-	-	-	-
2019	Circuit1907	2	2	3	2	3	5	5	4
2019	Circuit1908	144	144	142	143	145	146	146	146
2019	Circuit1910	667	655	655	659	676	679	679	678
2019	Circuit1912	1,533	1,536	1,531	1,533	1,526	1527	1527	1,527
2019	Circuit1926	19	19	16	18	22	26	26	25
2019	Circuit1009	751	753	751	752	752	753	753	753
2019	Circuit1010	736	736	734	735	548	499	499	515
2019	Circuit1011	418	418	414	417	421	418	418	419
2019	Circuit1012	422	422	422	422	427	428	428	428
2019	Circuit1013	550	550	550	550	553	551	551	552
2019	Circuit1014	691	688	686	688	659	661	661	660
2019	Circuit1016	624	624	622	623	626	625	625	625
2019	Circuit1017	612	611	607	610	616	615	615	615
2019	Circuit1018	432	432	429	431	381	432	432	415
2019	Circuit1019	1,038	1,035	1,032	1,035	1,035	1030	1030	1,032
2019	Circuit1022	1,051	1,055	1,059	1,055	1,056	1056	1056	1,056
2019	Circuit1023	327	326	322	325	328	327	327	327
2019	Circuit3760	-	-	-	-	-	-	-	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3732	-	-	-	-	-	-	-	-
2019	Circuit1936	5	4	3	4	4	5	5	5
2019	Circuit1938	3	3	2	3	4	4	4	4
2019	Circuit1939	474	463	458	465	484	501	501	495
2019	Circuit1940	747	715	730	731	789	884	884	852
2019	Circuit1941	646	670	675	664	709	723	723	718
2019	Circuit1024	55	54	52	54	50	52	52	51
2019	Circuit1026	277	276	278	277	283	286	286	285
2019	Circuit1028	174	176	178	176	181	180	180	180
2019	Circuit1029	47	50	50	49	53	51	51	52
2019	Circuit1030	220	220	220	220	233	233	233	233
2019	Circuit1031	1	1	2	1	2	2	2	2
2019	Circuit1032	106	109	108	108	109	111	111	110
2019	Circuit1033	123	127	126	125	216	217	217	217
2019	Circuit1034	30	30	27	29	82	90	90	87
2019	Circuit3725	-	-	-	-	-	-	-	-
2019	Circuit3726	-	-	-	-	-	-	-	-
2019	Circuit1037	-	-	-	-	-	0	0	-
2019	Circuit3746	-	-	-	-	-	-	-	-
2019	Circuit3729	-	-	-	-	-	-	-	-
2019	Circuit3484	81	79	78	79	80	88	88	85
2019	Circuit4113	-	-	-	-	-	-	-	-
2019	Circuit3722	41	-	-	14	-	-	-	-
2019	Circuit3486	43	43	41	42	49	50	50	50
2019	Circuit3487	78	80	75	78	78	83	83	81
2019	Circuit3488	-	39	37	25	40	40	40	40
2019	Circuit3489	-	885	889	591	892	898	898	896
2019	Circuit3490	-	760	769	510	778	779	779	779
2019	Circuit3690	762	-	-	254	-	-	-	-
2019	Circuit3491	948	948	948	948	1,013	1013	1013	1,013
2019	Circuit3492	462	460	454	459	457	456	456	456
2019	Circuit3493	809	808	809	809	820	819	819	819
2019	Circuit3494	-	-	-	-	-	0	0	-
2019	Circuit3759	-	-	-	-	-	-	-	-
2019	Circuit3495	616	614	613	614	615	615	615	615
2019	Circuit3496	664	615	607	629	639	643	643	642
2019	Circuit3497	789	788	789	789	789	797	797	794
2019	Circuit3498	503	501	498	501	496	504	504	501
2019	Circuit3499	911	913	915	913	916	915	915	915
2019	Circuit3501	992	996	992	993	1,010	1012	1012	1,011
2019	Circuit3502	1,570	1,591	1,586	1,582	1,149	1153	1153	1,152
2019	Circuit3503	716	718	716	717	736	733	733	734
2019	Circuit3509	688	689	682	686	705	720	720	715
2019	Circuit3510	987	1,013	1,008	1,003	1,020	1020	1020	1,020
2019	Circuit3511	384	385	379	383	853	848	848	850
2019	Circuit3513	217	213	212	214	274	269	269	271
2019	Circuit3723	-	-	-	-	-	-	-	-
2019	Circuit3684	-	-	-	-	-	0	0	-
2019	Circuit3685	-	-	-	-	-	0	0	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3535	-	-	-	-	-	0	0	-
2019	Circuit3686	38	-	-	13	-	0	0	-
2019	Circuit3536	2	1	1	1	2	2	2	2
2019	Circuit3687	-	-	-	-	-	0	0	-
2019	Circuit3537	31	29	25	28	31	29	29	30
2019	Circuit4114	-	-	-	-	-	-	-	-
2019	Circuit3688	1	1	1	1	-	0	0	-
2019	Circuit3619	1,110	1,115	1,126	1,117	-	0	0	-
2019	Circuit3621	1,196	1,182	1,197	1,192	-	0	0	-
2019	Circuit1047	-	591	647	413	646	655	655	652
2019	Circuit1048	804	-	832	545	864	875	875	871
2019	Circuit2376	-	-	-	-	1,242	1347	1347	1,312
2019	Circuit1049	-	-	1,107	369	1,128	1134	1134	1,132
2019	Circuit2377	-	-	-	-	1,956	1977	1977	1,970
2019	Circuit2378	-	-	-	-	1,680	1724	1724	1,709
2020	Circuit3715	-	-	-	-	-	-	-	-
2020	Circuit3720	-	-	-	-	-	-	-	-
2020	Circuit206	568	566	566	567	559	559	552	557
2020	Circuit208	857	856	856	856	857	857	853	856
2020	Circuit211	1,385	1,387	1,387	1,386	1,400	1400	1398	1,399
2020	Circuit2434	652	654	653	653	656	656	648	653
2020	Circuit2438	154	146	146	149	197	197	189	194
2020	Circuit2439	712	714	714	713	718	718	710	715
2020	Circuit3624	-	-	-	-	-	0	-	-
2020	Circuit2441	67	65	65	66	57	57	55	56
2020	Circuit2442	981	985	984	983	987	987	982	985
2020	Circuit2443	645	648	648	647	677	677	673	676
2020	Circuit2444	704	701	703	703	705	705	705	705
2020	Circuit2445	627	632	632	630	632	632	620	628
2020	Circuit2446	760	762	761	761	785	785	775	782
2020	Circuit2447	1,042	1,042	1,041	1,042	1,042	1042	1040	1,041
2020	Circuit4037	-	-	-	-	-	-	-	-
2020	Circuit4038	-	-	-	-	-	-	-	-
2020	Circuit4039	-	-	-	-	-	-	-	-
2020	Circuit4040	-	-	-	-	-	-	-	-
2020	Circuit4041	-	-	-	-	-	-	-	-
2020	Circuit4042	-	-	-	-	-	-	-	-
2020	Circuit4043	-	-	-	-	-	-	-	-
2020	Circuit3625	-	-	-	-	-	0	-	-
2020	Circuit2455	88	85	84	86	91	91	88	90
2020	Circuit2460	281	278	279	279	284	284	275	281
2020	Circuit2466	3	3	3	3	8	8	7	8
2020	Circuit2472	108	103	105	105	111	111	96	106
2020	Circuit2473	759	762	765	762	798	798	779	792
2020	Circuit2474	680	680	679	680	811	811	818	813
2020	Circuit1595	-	-	-	-	-	0	0	-
2020	Circuit3741	-	-	-	-	-	-	-	-
2020	Circuit4095	-	-	-	-	-	-	-	-
2020	Circuit2527	-	-	-	-	-	0	0	-

Year	Circuit	Customer Count Control Group						
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after
2020	Circuit4096	-	-	-	-	-	-	-
2020	Circuit2019	26	26	26	26	28	28	27
2020	Circuit2020	188	185	185	186	194	194	188
2020	Circuit2023	803	804	804	804	1,058	1058	1069
2020	Circuit2025	607	602	602	604	1,568	1568	595
2020	Circuit1628	-	-	-	-	-	0	0
2020	Circuit3728	-	-	-	-	-	-	-
2020	Circuit1629	692	693	693	693	694	694	694
2020	Circuit1630	894	897	897	896	900	900	897
2020	Circuit1631	583	583	583	583	584	584	584
2020	Circuit1632	625	626	625	625	631	631	626
2020	Circuit1633	1,121	1,110	1,121	1,117	1,136	1136	1127
2020	Circuit2559	643	640	640	641	647	647	640
2020	Circuit1634	385	386	385	385	383	383	385
2020	Circuit2566	158	155	154	156	161	161	159
2020	Circuit2578	1,279	1,289	1,289	1,286	1,288	1288	1289
2020	Circuit2579	737	740	738	738	741	741	735
2020	Circuit3730	-	-	-	-	-	-	-
2020	Circuit1238	1	-	-	0	1	1	1
2020	Circuit1241	-	-	-	-	-	0	0
2020	Circuit1244	634	628	628	630	635	635	416
2020	Circuit1245	554	557	557	556	558	558	548
2020	Circuit1246	430	433	432	432	345	345	335
2020	Circuit3710	-	-	-	-	-	-	-
2020	Circuit828	790	792	796	793	902	902	834
2020	Circuit829	992	1,028	1,028	1,016	1,124	1124	1227
2020	Circuit830	739	765	760	755	835	835	726
2020	Circuit832	626	664	665	652	730	730	684
2020	Circuit835	603	616	613	611	675	675	606
2020	Circuit2666	-	-	-	-	-	-	-
2020	Circuit4093	-	-	-	-	-	-	-
2020	Circuit3638	-	-	-	-	-	0	-
2020	Circuit4097	-	-	-	-	-	-	-
2020	Circuit3639	1	-	-	0	-	0	-
2020	Circuit4098	-	-	-	-	-	-	-
2020	Circuit3578	532	-	-	177	-	0	-
2020	Circuit2679	-	-	-	-	30	30	28
2020	Circuit2681	-	-	-	-	1,057	1057	911
2020	Circuit3736	-	-	-	-	-	-	-
2020	Circuit3733	-	-	-	-	-	-	-
2020	Circuit1663	307	302	302	304	311	311	306
2020	Circuit1664	719	717	717	718	724	724	717
2020	Circuit1665	517	518	518	518	519	519	514
2020	Circuit1666	1,329	1,327	1,327	1,328	1,101	1101	1096
2020	Circuit1668	790	793	793	792	798	798	794
2020	Circuit1669	991	992	992	992	972	972	971
2020	Circuit3743	-	-	-	-	-	-	-
2020	Circuit3742	-	-	-	-	-	-	-
2020	Circuit3739	-	-	-	-	-	-	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3711	-	-	-	-	-	-	-	-
2020	Circuit3751	-	-	-	-	-	-	-	-
2020	Circuit1684	527	527	527	527	527	527	521	525
2020	Circuit1685	1,039	1,037	1,038	1,038	1,041	1041	1130	1,071
2020	Circuit1686	1,287	1,299	1,299	1,295	1,297	1297	1280	1,291
2020	Circuit1687	779	779	778	779	787	787	784	786
2020	Circuit1688	1,420	1,427	1,426	1,424	1,421	1421	1383	1,408
2020	Circuit2729	4	3	3	3	5	5	4	5
2020	Circuit2730	8	4	5	6	7	7	4	6
2020	Circuit2731	-	-	-	-	-	0	0	-
2020	Circuit2732	3	3	3	3	5	5	4	5
2020	Circuit2733	57	52	52	54	61	61	60	61
2020	Circuit2734	457	458	458	458	340	340	450	377
2020	Circuit2737	1,033	1,055	1,056	1,048	1,063	1063	994	1,040
2020	Circuit2738	375	381	381	379	516	516	355	462
2020	Circuit2739	932	936	935	934	938	938	926	934
2020	Circuit2740	1,169	1,175	1,176	1,173	1,174	1174	1169	1,172
2020	Circuit2741	644	666	663	658	676	676	622	658
2020	Circuit2742	1,335	1,378	1,368	1,360	1,460	1460	1383	1,434
2020	Circuit2744	785	793	791	790	804	804	785	798
2020	Circuit2745	818	819	818	818	822	822	812	819
2020	Circuit2746	975	977	976	976	982	982	976	980
2020	Circuit2752	1,109	1,107	1,107	1,108	1,110	1110	1107	1,109
2020	Circuit2753	832	836	836	835	843	843	836	841
2020	Circuit2754	865	866	866	866	870	870	864	868
2020	Circuit2755	603	601	601	602	607	607	603	606
2020	Circuit2756	323	327	327	326	328	328	322	326
2020	Circuit4087	-	-	-	-	-	-	-	-
2020	Circuit875	652	658	657	656	666	666	653	662
2020	Circuit876	1,127	1,155	1,155	1,146	1,191	1191	1153	1,178
2020	Circuit4099	-	-	-	-	-	-	-	-
2020	Circuit4100	-	-	-	-	-	-	-	-
2020	Circuit3712	-	-	-	-	-	-	-	-
2020	Circuit3716	-	-	-	-	-	-	-	-
2020	Circuit3641	-	-	-	-	-	0	-	-
2020	Circuit3642	-	-	-	-	-	-	-	-
2020	Circuit3587	678	661	661	667	-	0	-	-
2020	Circuit1701	1,010	999	999	1,003	-	0	-	-
2020	Circuit3588	1,206	1,203	1,203	1,204	-	0	-	-
2020	Circuit2058	-	-	-	-	-	0	0	-
2020	Circuit2060	647	647	647	647	646	646	645	646
2020	Circuit4088	-	-	-	-	-	-	-	-
2020	Circuit2790	478	471	470	473	488	488	484	487
2020	Circuit2791	673	673	673	673	675	675	673	674
2020	Circuit2792	491	495	495	494	501	501	494	499
2020	Circuit3750	-	-	-	-	-	-	-	-
2020	Circuit2794	397	393	393	394	410	410	410	410
2020	Circuit3754	-	-	-	-	-	-	-	-
2020	Circuit2795	-	-	-	-	1	1	1	1

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2807	757	754	754	755	762	762	760	761
2020	Circuit2808	657	656	655	656	659	659	653	657
2020	Circuit881	1	1	1	1	1	1	1	1
2020	Circuit887	269	280	280	276	511	511	456	493
2020	Circuit888	336	332	334	334	447	447	397	430
2020	Circuit2063	335	333	334	334	329	329	326	328
2020	Circuit3745	-	-	-	-	-	-	-	-
2020	Circuit3755	-	-	-	-	-	-	-	-
2020	Circuit3718	-	-	-	-	-	-	-	-
2020	Circuit2066	-	-	-	-	-	0	0	-
2020	Circuit2067	219	209	209	212	218	218	207	214
2020	Circuit2068	1,010	1,005	1,005	1,007	1,022	1022	1021	1,022
2020	Circuit2070	864	866	866	865	721	721	702	715
2020	Circuit2071	593	595	595	594	600	600	590	597
2020	Circuit2072	437	434	434	435	448	448	445	447
2020	Circuit3740	-	-	-	-	-	-	-	-
2020	Circuit3622	-	-	-	-	-	-	-	-
2020	Circuit3643	-	-	5	2	-	0	-	-
2020	Circuit3623	132	132	132	132	-	-	-	-
2020	Circuit4101	-	-	-	-	-	-	-	-
2020	Circuit897	191	191	191	191	192	192	194	193
2020	Circuit898	-	-	-	-	-	0	0	-
2020	Circuit901	114	110	109	111	113	113	112	113
2020	Circuit903	187	187	184	186	191	191	161	181
2020	Circuit3734	-	-	-	-	-	-	-	-
2020	Circuit1708	1,050	1,091	1,089	1,077	1,135	1135	1047	1,106
2020	Circuit1709	712	733	732	726	743	743	696	727
2020	Circuit4102	-	-	-	-	-	-	-	-
2020	Circuit4103	-	-	-	-	-	-	-	-
2020	Circuit2083	785	785	784	785	784	784	783	784
2020	Circuit2084	582	583	583	583	578	578	573	576
2020	Circuit2085	781	788	790	786	792	792	786	790
2020	Circuit2086	-	-	-	-	-	0	0	-
2020	Circuit3731	-	-	-	-	-	-	-	-
2020	Circuit2087	389	392	392	391	720	720	713	718
2020	Circuit2088	1,680	1,684	1,687	1,684	1,663	1663	1331	1,552
2020	Circuit3744	-	-	-	-	-	-	-	-
2020	Circuit1716	-	-	-	-	-	0	0	-
2020	Circuit1719	3	1	1	2	4	4	4	4
2020	Circuit1726	-	-	-	-	-	0	0	-
2020	Circuit4104	-	-	-	-	-	-	-	-
2020	Circuit1727	40	25	25	30	28	28	27	28
2020	Circuit1728	102	99	99	100	100	100	101	100
2020	Circuit1729	11	34	33	26	38	38	38	38
2020	Circuit1730	18	14	14	15	17	17	16	17
2020	Circuit1732	922	1,043	1,044	1,003	1,098	1098	1052	1,083
2020	Circuit1733	768	772	771	770	772	772	735	760
2020	Circuit1734	946	944	945	945	944	944	942	943
2020	Circuit1735	873	871	871	872	1,017	1017	1012	1,015

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit1736	781	783	783	782	783	783	781	782
2020	Circuit1737	995	979	979	984	982	982	980	981
2020	Circuit1738	1,283	1,288	1,288	1,286	1,473	1473	1462	1,469
2020	Circuit1739	825	828	827	827	845	845	838	843
2020	Circuit4094	-	-	-	-	-	-	-	-
2020	Circuit2859	679	682	682	681	683	683	686	684
2020	Circuit1401	371	371	371	371	384	384	379	382
2020	Circuit1402	678	679	678	678	684	684	688	685
2020	Circuit3738	-	-	-	-	-	-	-	-
2020	Circuit4105	-	-	-	-	-	-	-	-
2020	Circuit3644	1	-	-	0	-	0	-	-
2020	Circuit3756	-	-	-	-	-	-	-	-
2020	Circuit2862	21	16	16	18	20	20	18	19
2020	Circuit2863	30	29	29	29	100	100	100	100
2020	Circuit2864	202	202	202	202	212	212	185	203
2020	Circuit2865	737	737	737	737	746	746	742	745
2020	Circuit2866	809	804	803	805	817	817	801	812
2020	Circuit2867	-	-	-	-	-	0	0	-
2020	Circuit2869	541	542	543	542	540	540	530	537
2020	Circuit2870	1,367	1,372	1,371	1,370	1,378	1378	1364	1,373
2020	Circuit2877	871	875	875	874	879	879	861	873
2020	Circuit2878	-	-	-	-	-	0	0	-
2020	Circuit2879	514	517	517	516	516	516	517	516
2020	Circuit2881	1,196	1,203	1,203	1,201	1,203	1203	1147	1,184
2020	Circuit2882	310	310	310	310	316	316	312	315
2020	Circuit2884	890	894	895	893	903	903	890	899
2020	Circuit2885	1,741	1,743	1,743	1,742	1,748	1748	1737	1,744
2020	Circuit2886	683	684	684	684	684	684	687	685
2020	Circuit2887	534	536	534	535	539	539	535	538
2020	Circuit2888	962	967	967	965	1,062	1062	1068	1,064
2020	Circuit2889	836	840	840	839	846	846	844	845
2020	Circuit2890	760	761	761	761	764	764	763	764
2020	Circuit2895	636	629	629	631	634	634	635	634
2020	Circuit1744	-	-	-	-	-	0	0	-
2020	Circuit3727	-	-	-	-	-	-	-	-
2020	Circuit3719	-	-	-	-	-	-	-	-
2020	Circuit3590	18	16	16	17	-	0	-	-
2020	Circuit3591	60	56	55	57	-	0	-	-
2020	Circuit3592	715	750	897	787	-	0	-	-
2020	Circuit3594	516	514	368	466	-	0	-	-
2020	Circuit3595	1,096	1,083	1,083	1,087	-	0	-	-
2020	Circuit1752	327	326	326	326	326	326	326	326
2020	Circuit1753	508	507	507	507	518	518	515	517
2020	Circuit1759	689	692	692	691	692	692	692	692
2020	Circuit1754	543	545	545	544	549	549	543	547
2020	Circuit1755	409	408	408	408	409	409	409	409
2020	Circuit1756	546	547	547	547	548	548	542	546
2020	Circuit4106	-	-	-	-	-	-	-	-
2020	Circuit3646	-	-	-	-	-	0	-	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2931	-	-	-	-	-	0	0	-
2020	Circuit2932	394	409	408	404	420	420	393	411
2020	Circuit2933	756	756	755	756	751	751	738	747
2020	Circuit2934	1,108	1,125	1,126	1,120	1,152	1,152	1,131	1,145
2020	Circuit2935	1,041	1,062	1,064	1,056	1,096	1,096	1,063	1,085
2020	Circuit2936	112	109	110	110	116	116	108	113
2020	Circuit2937	312	315	315	314	319	319	307	315
2020	Circuit1764	-	-	-	-	-	0	1	0
2020	Circuit1765	-	-	-	-	-	0	0	-
2020	Circuit1250	16	15	15	15	17	17	16	17
2020	Circuit1252	329	329	328	329	364	364	351	360
2020	Circuit1253	1,059	1,071	1,071	1,067	1,087	1,087	966	1,047
2020	Circuit1255	930	936	936	934	953	953	956	954
2020	Circuit1256	1,341	899	899	1,046	1,330	1,330	1,346	1,335
2020	Circuit1257	154	157	157	156	149	149	146	148
2020	Circuit944	468	477	475	473	527	527	521	525
2020	Circuit945	28	23	23	25	27	27	23	26
2020	Circuit946	283	271	272	275	636	636	623	632
2020	Circuit947	169	162	159	163	224	224	200	216
2020	Circuit3649	2	1	1	1	-	0	-	-
2020	Circuit3650	-	-	-	-	-	0	-	-
2020	Circuit3651	-	-	-	-	-	0	-	-
2020	Circuit1766	497	491	491	493	507	507	490	501
2020	Circuit1768	433	425	425	428	437	437	431	435
2020	Circuit1769	657	651	650	653	659	659	658	659
2020	Circuit1771	8	4	4	5	13	13	15	14
2020	Circuit1772	368	365	365	366	372	372	370	371
2020	Circuit1773	767	781	782	777	831	831	834	832
2020	Circuit1774	551	549	548	549	678	678	670	675
2020	Circuit948	-	-	-	-	1	1	1	1
2020	Circuit951	389	403	400	397	422	422	370	405
2020	Circuit952	523	532	532	529	557	557	519	544
2020	Circuit953	453	464	467	461	483	483	447	471
2020	Circuit954	591	597	591	593	611	611	548	590
2020	Circuit955	365	369	367	367	385	385	353	374
2020	Circuit4089	-	-	-	-	-	-	-	-
2020	Circuit2992	-	-	-	-	-	0	0	-
2020	Circuit2993	24	20	20	21	21	21	19	20
2020	Circuit2994	51	22	22	32	49	49	49	49
2020	Circuit2995	855	865	865	862	877	877	864	873
2020	Circuit2996	678	682	682	681	685	685	678	683
2020	Circuit2997	465	467	467	466	470	470	459	466
2020	Circuit2998	983	983	983	983	994	994	994	994
2020	Circuit2999	724	724	718	722	722	722	715	720
2020	Circuit3737	-	-	-	-	-	-	-	-
2020	Circuit959	-	-	-	-	-	0	0	-
2020	Circuit3656	-	-	-	-	-	0	-	-
2020	Circuit4107	-	-	-	-	-	-	-	-
2020	Circuit3598	-	-	168	56	-	0	-	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3041	553	559	557	556	566	566	553	562
2020	Circuit3049	-	-	-	-	-	-	-	-
2020	Circuit3050	-	-	-	-	-	-	-	-
2020	Circuit3051	-	-	-	-	-	-	-	-
2020	Circuit3052	-	-	-	-	-	-	-	-
2020	Circuit3056	100	94	94	96	111	111	100	107
2020	Circuit3064	406	403	404	404	355	355	348	353
2020	Circuit3065	906	900	900	902	907	907	587	800
2020	Circuit3066	855	857	857	856	856	856	852	855
2020	Circuit3068	1	-	-	0	1	1	1	1
2020	Circuit3069	12	8	8	9	12	12	9	11
2020	Circuit1779	807	800	799	802	757	757	741	752
2020	Circuit3070	535	532	532	533	526	526	520	524
2020	Circuit3071	642	639	639	640	653	653	682	663
2020	Circuit3072	289	287	287	288	1,121	1121	1120	1,121
2020	Circuit3073	550	548	549	549	610	610	615	612
2020	Circuit3074	669	669	669	669	906	906	905	906
2020	Circuit1780	37	33	33	34	384	384	374	381
2020	Circuit1781	-	-	-	-	-	0	-	-
2020	Circuit1782	22	21	20	21	22	22	22	22
2020	Circuit1783	17	17	16	17	18	18	0	12
2020	Circuit4108	-	-	-	-	-	-	-	-
2020	Circuit1785	40	35	36	37	39	39	34	37
2020	Circuit1786	-	-	-	-	1	1	4	2
2020	Circuit1788	7	7	7	7	9	9	24	14
2020	Circuit1789	708	709	710	709	714	714	681	703
2020	Circuit1790	719	713	712	715	411	411	399	407
2020	Circuit1791	644	640	639	641	668	668	662	666
2020	Circuit1792	1,367	1,374	1,373	1,371	1,439	1439	1354	1,411
2020	Circuit1793	483	477	479	480	468	468	415	450
2020	Circuit1794	896	902	906	901	935	935	-	935
2020	Circuit1795	211	204	204	206	239	239	230	236
2020	Circuit4109	-	-	-	-	-	-	-	-
2020	Circuit3657	52	-	-	17	-	0	-	-
2020	Circuit3658	-	-	-	-	-	0	-	-
2020	Circuit3606	27	29	29	28	-	0	-	-
2020	Circuit3607	8	2	2	4	-	0	-	-
2020	Circuit3608	2	1	1	1	-	0	0	-
2020	Circuit3609	5	4	4	4	-	0	-	-
2020	Circuit3659	-	-	-	-	-	0	-	-
2020	Circuit3660	-	-	-	-	-	0	-	-
2020	Circuit3661	3	3	3	3	-	0	-	-
2020	Circuit3713	-	-	-	-	-	-	-	-
2020	Circuit3662	-	-	-	-	-	0	-	-
2020	Circuit3663	49	48	48	48	-	0	-	-
2020	Circuit3611	151	157	158	155	-	0	-	-
2020	Circuit3714	-	-	-	-	-	-	-	-
2020	Circuit3094	-	-	-	-	-	0	0	-
2020	Circuit3096	35	31	30	32	36	36	34	35

4.0kV Hardening Data		Customer Count Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3097	1,189	1,198	1,197	1,195	1,198	1198	1186	1,194
2020	Circuit3099	1,014	1,018	1,017	1,016	1,023	1023	1010	1,019
2020	Circuit3747	-	-	-	-	-	-	-	-
2020	Circuit3100	622	622	622	622	626	626	623	625
2020	Circuit3101	1,195	1,202	1,201	1,199	1,242	1242	1237	1,240
2020	Circuit3102	878	879	879	879	886	886	887	886
2020	Circuit3758	-	-	-	-	-	-	-	-
2020	Circuit1798	759	785	783	776	885	885	823	864
2020	Circuit1799	1,037	1,066	1,072	1,058	1,213	1213	1119	1,182
2020	Circuit1800	641	674	672	662	766	766	719	750
2020	Circuit1801	802	829	829	820	938	938	857	911
2020	Circuit1802	737	767	766	757	883	883	809	858
2020	Circuit1803	27	27	27	27	35	35	36	35
2020	Circuit1804	532	549	548	543	623	623	565	604
2020	Circuit1805	22	17	17	19	22	22	22	22
2020	Circuit1808	-	-	-	-	-	0	0	-
2020	Circuit1423	-	-	-	-	-	0	0	-
2020	Circuit3124	37	36	36	36	38	38	40	39
2020	Circuit3126	25	20	20	22	28	28	25	27
2020	Circuit3127	-	-	-	-	-	0	-	-
2020	Circuit3128	-	-	-	-	-	0	0	-
2020	Circuit3665	-	-	-	-	-	0	-	-
2020	Circuit3131	859	877	870	869	946	946	950	947
2020	Circuit3748	-	-	-	-	-	-	-	-
2020	Circuit4090	-	-	-	-	-	-	-	-
2020	Circuit1812	65	59	59	61	65	65	61	64
2020	Circuit1815	26	24	23	24	24	24	20	23
2020	Circuit1816	2	2	2	2	2	2	2	2
2020	Circuit3666	-	-	-	-	-	-	-	-
2020	Circuit1817	1	1	1	1	2	2	2	2
2020	Circuit3667	-	-	-	-	-	0	-	-
2020	Circuit1818	11	9	9	10	11	11	10	11
2020	Circuit1819	39	30	30	33	39	39	38	39
2020	Circuit1820	431	444	444	440	483	483	431	466
2020	Circuit1821	811	797	797	802	807	807	786	800
2020	Circuit1822	73	66	67	69	71	71	65	69
2020	Circuit1823	1,322	1,326	1,327	1,325	1,334	1334	1314	1,327
2020	Circuit1824	1,205	1,219	1,220	1,215	1,288	1288	1245	1,274
2020	Circuit1825	1,208	1,209	1,209	1,209	1,214	1214	1200	1,209
2020	Circuit1826	808	809	809	809	814	814	813	814
2020	Circuit3156	1	-	-	0	8	8	8	8
2020	Circuit3668	-	-	-	-	-	-	-	-
2020	Circuit1269	-	-	-	-	-	0	0	-
2020	Circuit1270	-	-	-	-	-	0	0	-
2020	Circuit1827	502	498	498	499	503	503	497	501
2020	Circuit1828	574	577	577	576	578	578	576	577
2020	Circuit1829	251	249	249	250	252	252	252	252
2020	Circuit1830	687	689	689	688	689	689	682	687
2020	Circuit3184	73	72	72	72	75	75	70	73

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4.8kV Hardening Data

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3185	1,667	1,677	1,677	1,674	1,636	1636	1622	1,631
2020	Circuit3186	720	722	722	721	723	723	720	722
2020	Circuit3187	713	713	714	713	720	720	719	720
2020	Circuit3188	388	388	388	388	448	448	446	447
2020	Circuit3189	-	-	-	-	-	0	0	-
2020	Circuit3190	538	538	538	538	512	512	542	522
2020	Circuit3192	1,121	1,125	1,125	1,124	1,128	1128	1122	1,126
2020	Circuit3193	451	450	450	450	78	78	436	197
2020	Circuit3753	-	-	-	-	-	-	-	-
2020	Circuit3194	1,021	1,020	1,020	1,020	1,030	1030	1019	1,026
2020	Circuit3669	-	-	-	-	-	0	-	-
2020	Circuit3195	1,182	1,194	1,194	1,190	1,199	1199	1195	1,198
2020	Circuit1839	509	489	489	496	532	532	526	530
2020	Circuit1845	415	417	417	416	419	419	418	419
2020	Circuit1846	217	220	220	219	220	220	214	218
2020	Circuit1847	301	310	310	307	317	317	313	316
2020	Circuit1848	670	681	681	677	766	766	759	764
2020	Circuit1849	267	266	265	266	280	280	263	274
2020	Circuit1850	11	9	9	10	10	10	9	10
2020	Circuit1851	229	225	224	226	235	235	232	234
2020	Circuit1852	20	17	17	18	13	13	12	13
2020	Circuit1853	149	150	150	150	416	416	411	414
2020	Circuit1854	391	380	380	384	125	125	125	125
2020	Circuit3752	-	-	-	-	-	-	-	-
2020	Circuit4110	-	-	-	-	-	-	-	-
2020	Circuit1434	433	433	433	433	444	444	442	443
2020	Circuit3253	-	-	-	-	-	0	0	-
2020	Circuit1438	-	-	-	-	-	0	0	-
2020	Circuit4091	-	-	-	-	-	-	-	-
2020	Circuit3749	-	-	-	-	-	-	-	-
2020	Circuit3717	-	-	-	-	-	-	-	-
2020	Circuit3735	-	-	-	-	-	-	-	-
2020	Circuit979	-	-	-	-	-	0	0	-
2020	Circuit980	-	-	-	-	-	0	0	-
2020	Circuit3677	-	-	-	-	-	0	-	-
2020	Circuit981	1	-	-	0	1	1	1	1
2020	Circuit3302	-	-	-	-	-	0	0	-
2020	Circuit3303	-	-	-	-	-	0	0	-
2020	Circuit1877	1	-	-	0	2	2	2	2
2020	Circuit2150	795	795	793	794	904	904	825	878
2020	Circuit3721	-	-	-	-	-	-	-	-
2020	Circuit3314	40	36	36	37	38	38	34	37
2020	Circuit3315	-	-	-	-	-	0	0	-
2020	Circuit3316	347	348	347	347	344	344	341	343
2020	Circuit3317	632	651	651	645	637	637	635	636
2020	Circuit3318	383	384	384	384	392	392	386	390
2020	Circuit3319	635	633	633	634	614	614	613	614
2020	Circuit3320	1,021	1,029	1,029	1,026	1,031	1031	1030	1,031
2020	Circuit3321	840	840	840	840	859	859	858	859

4.8KV Hardening Data

		Customer Count Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3322	405	406	406	406	410	410	406	409
2020	Circuit3323	617	616	616	616	620	620	619	620
2020	Circuit3324	678	680	679	679	934	934	936	935
2020	Circuit3757	-	-	-	-	-	-	-	-
2020	Circuit3338	-	-	-	-	-	0	1	0
2020	Circuit3353	-	-	-	-	-	-	-	-
2020	Circuit1314	-	-	-	-	-	0	0	-
2020	Circuit3395	878	895	892	888	1,055	1055	1032	1,047
2020	Circuit4111	-	-	-	-	-	-	-	-
2020	Circuit3397	375	375	375	375	384	384	391	386
2020	Circuit3398	542	525	524	530	539	539	520	533
2020	Circuit3399	3	2	2	2	4	4	3	4
2020	Circuit3400	755	756	756	756	767	767	749	761
2020	Circuit1461	1	1	1	1	-	0	0	-
2020	Circuit3724	-	-	-	-	-	-	-	-
2020	Circuit4112	-	-	-	-	-	-	-	-
2020	Circuit1926	19	16	16	17	26	26	23	25
2020	Circuit1009	753	751	751	752	753	753	749	752
2020	Circuit1010	736	734	734	735	499	499	497	498
2020	Circuit1012	422	422	422	422	428	428	427	428
2020	Circuit1013	550	550	550	550	551	551	551	551
2020	Circuit1014	688	686	685	686	661	661	659	660
2020	Circuit1016	624	622	622	623	625	625	625	625
2020	Circuit1017	611	607	607	608	615	615	614	615
2020	Circuit1018	432	429	429	430	432	432	424	429
2020	Circuit1019	1,035	1,032	1,032	1,033	1,030	1030	1028	1,029
2020	Circuit1022	1,055	1,059	1,058	1,057	1,056	1056	1045	1,052
2020	Circuit1023	326	322	322	323	327	327	325	326
2020	Circuit3760	-	-	-	-	-	-	-	-
2020	Circuit3732	-	-	-	-	-	-	-	-
2020	Circuit1030	220	220	220	220	233	233	230	232
2020	Circuit3725	-	-	-	-	-	-	-	-
2020	Circuit3726	-	-	-	-	-	-	-	-
2020	Circuit1037	-	-	-	-	-	0	0	-
2020	Circuit3746	-	-	-	-	-	-	-	-
2020	Circuit3729	-	-	-	-	-	-	-	-
2020	Circuit3484	79	78	78	78	88	88	85	87
2020	Circuit4113	-	-	-	-	-	-	-	-
2020	Circuit3722	-	-	-	-	-	-	-	-
2020	Circuit3486	43	41	41	42	50	50	41	47
2020	Circuit3487	80	75	76	77	83	83	79	82
2020	Circuit3488	39	37	37	38	40	40	41	40
2020	Circuit3489	885	889	889	888	898	898	889	895
2020	Circuit3490	760	769	769	766	779	779	766	775
2020	Circuit3690	-	-	-	-	-	-	-	-
2020	Circuit3491	948	948	948	948	1,013	1013	999	1,008
2020	Circuit3492	460	454	454	456	456	456	448	453
2020	Circuit3493	808	809	809	809	819	819	816	818
2020	Circuit3494	-	-	-	-	-	0	0	-

Year	Circuit	Customer Count Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3759	-	-	-	-	-	-	-	-
2020	Circuit3495	614	613	611	613	615	615	601	610
2020	Circuit3496	615	607	608	610	643	643	658	648
2020	Circuit3497	788	789	788	788	797	797	792	795
2020	Circuit3498	501	498	498	499	504	504	498	502
2020	Circuit3499	913	915	915	914	915	915	900	910
2020	Circuit3501	996	992	993	994	1,012	1012	1005	1,010
2020	Circuit3502	1,591	1,586	1,586	1,588	1,153	1153	1148	1,151
2020	Circuit3503	718	716	716	717	733	733	740	735
2020	Circuit3509	689	682	683	685	720	720	711	717
2020	Circuit3510	1,013	1,008	1,008	1,010	1,020	1020	1016	1,019
2020	Circuit3511	385	379	378	381	848	848	828	841
2020	Circuit3513	213	212	212	212	269	269	225	254
2020	Circuit3723	-	-	-	-	-	-	-	-
2020	Circuit3684	-	-	-	-	-	0	-	-
2020	Circuit3685	-	-	-	-	-	0	-	-
2020	Circuit3535	-	-	-	-	-	0	0	-
2020	Circuit3686	-	-	-	-	-	0	-	-
2020	Circuit3536	1	1	1	1	2	2	2	2
2020	Circuit3687	-	-	-	-	-	0	-	-
2020	Circuit3537	29	25	25	26	29	29	28	29
2020	Circuit4114	-	-	-	-	-	-	-	-
2020	Circuit3688	1	1	1	1	-	0	-	-
2020	Circuit3619	1,115	1,126	1,128	1,123	-	0	-	-
2020	Circuit3621	1,182	1,197	1,195	1,191	-	0	-	-
2020	Circuit2376	-	-	-	-	1,347	1347	1262	1,319
2020	Circuit2377	-	-	-	-	1,977	1977	1888	1,947
2020	Circuit2378	-	-	-	-	1,724	1724	1657	1,702

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4.8kV Hardening Data

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Total 2018-2020 8,240 9,566 11,869 9,892 11,886 11,760 10,274 11,307

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit206	8	1	14	8	9	1	3	4
2018	Circuit208	4	4	5	4	3	2	6	4
2018	Circuit209	16	8	20	15	31	6	4	14
2018	Circuit211	7	12	23	14	6	10	9	8
2018	Circuit2434	1	2	3	2	9	9	4	7
2018	Circuit2436	9	4	8	7	11	7	4	7
2018	Circuit2438	0	0	5	2	6	3	1	3
2018	Circuit2439	4	4	13	7	4	8	6	6
2018	Circuit3624	0	0	0	0	0	0	0	0
2018	Circuit2440	5	1	2	3	2	2	6	3
2018	Circuit2441	1	0	0	0	2	0	0	1
2018	Circuit2442	4	10	5	6	13	7	15	12
2018	Circuit2443	9	3	14	9	6	8	9	8
2018	Circuit2444	3	10	6	6	3	10	7	7
2018	Circuit2445	13	1	9	8	7	2	7	5
2018	Circuit2446	6	2	7	5	10	11	6	9
2018	Circuit2447	5	3	13	7	9	4	13	9
2018	Circuit4092	0	0	0	0	0	0	0	0
2018	Circuit3625	0	0	0	0	0	0	0	0
2018	Circuit2455	0	1	4	2	0	0	0	0
2018	Circuit2460	1	0	1	1	2	2	2	2
2018	Circuit2466	0	0	1	0	0	0	0	0
2018	Circuit2472	6	1	6	4	1	2	4	2
2018	Circuit2473	1	0	5	2	2	6	2	3
2018	Circuit2474	1	1	1	1	1	6	2	3
2018	Circuit1595	0	0	0	0	0	0	0	0
2018	Circuit1596	1	2	2	2	0	1	0	0
2018	Circuit1597	1	1	2	1	0	3	1	1
2018	Circuit1598	17	8	25	17	25	19	26	23
2018	Circuit1599	2	3	8	4	8	11	14	11
2018	Circuit1600	12	10	7	10	25	10	13	16
2018	Circuit1601	10	6	33	16	19	24	17	20
2018	Circuit1602	5	3	8	5	2	5	11	6
2018	Circuit1603	5	3	8	5	13	3	7	8
2018	Circuit1604	14	16	5	12	15	5	7	9
2018	Circuit1605	18	13	16	16	25	24	26	25
2018	Circuit1606	6	16	18	13	9	11	19	13
2018	Circuit1607	16	9	22	16	17	11	22	17
2018	Circuit3741	3	0	0	1	0	0	0	0
2018	Circuit1219	3	2	6	4	2	5	4	4
2018	Circuit2015	1	0	1	1	0	0	0	0
2018	Circuit2016	1	2	15	6	1	4	1	2
2018	Circuit2017	1	1	6	3	4	1	8	4

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2527	0	0	0	0	0	0	0	0
2018	Circuit2019	1	1	1	1	0	1	1	1
2018	Circuit2020	3	1	4	3	0	0	1	0
2018	Circuit2021	0	0	0	0	0	0	0	0
2018	Circuit2022	9	10	15	11	12	10	18	13
2018	Circuit2023	8	4	30	14	7	5	8	7
2018	Circuit2024	5	4	11	7	0	3	9	4
2018	Circuit2025	6	6	11	8	4	9	13	9
2018	Circuit1622	5	6	13	8	15	15	20	17
2018	Circuit1623	5	1	4	3	3	4	5	4
2018	Circuit1624	7	8	44	20	19	17	10	15
2018	Circuit1625	0	0	0	0	1	0	0	0
2018	Circuit1626	4	8	15	9	4	10	6	7
2018	Circuit1627	10	2	9	7	15	3	6	8
2018	Circuit3728	0	0	0	0	0	0	0	0
2018	Circuit1629	7	2	8	6	6	17	17	13
2018	Circuit1630	7	9	21	12	19	10	8	12
2018	Circuit1631	6	2	3	4	17	10	34	20
2018	Circuit1632	5	4	7	5	5	3	9	6
2018	Circuit1633	5	2	17	8	2	5	22	10
2018	Circuit2559	2	3	10	5	7	6	13	9
2018	Circuit1634	6	5	6	6	4	4	19	9
2018	Circuit2566	1	2	4	2	1	6	11	6
2018	Circuit1392	4	3	2	3	9	0	0	3
2018	Circuit3761	0	4	1	2	0	0	0	0
2018	Circuit2578	11	3	17	10	26	13	28	22
2018	Circuit2579	2	5	9	5	5	11	9	8
2018	Circuit3730	0	0	0	0	0	0	0	0
2018	Circuit1237	0	1	1	1	0	1	3	1
2018	Circuit1238	0	0	0	0	0	0	0	0
2018	Circuit1239	2	1	4	2	7	5	17	10
2018	Circuit1240	1	6	1	3	7	0	5	4
2018	Circuit1241	0	0	0	0	0	0	0	0
2018	Circuit1242	2	2	1	2	10	6	3	6
2018	Circuit1243	0	5	11	5	8	10	14	11
2018	Circuit1244	1	3	0	1	13	3	8	8
2018	Circuit1245	0	1	7	3	10	6	5	7
2018	Circuit1246	3	3	3	3	5	7	3	5
2018	Circuit3710	2	0	0	1	1	0	0	0
2018	Circuit820	1	0	1	1	4	0	0	1
2018	Circuit825	0	0	0	0	0	0	0	0
2018	Circuit826	0	0	0	0	1	2	1	1
2018	Circuit827	0	1	3	1	4	4	3	4
2018	Circuit828	22	24	24	23	45	27	25	32
2018	Circuit829	19	21	53	31	44	36	16	32

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit830	4	15	18	12	27	14	17	19
2018	Circuit831	1	0	4	2	3	1	0	1
2018	Circuit832	13	12	23	16	26	33	23	27
2018	Circuit833	12	12	8	11	11	22	7	13
2018	Circuit834	6	3	10	6	6	5	13	8
2018	Circuit835	23	13	28	21	24	34	35	31
2018	Circuit836	10	14	12	12	24	13	20	19
2018	Circuit837	4	0	4	3	3	4	2	3
2018	Circuit838	19	14	23	19	17	34	17	23
2018	Circuit1641	3	1	8	4	2	3	4	3
2018	Circuit1646	26	8	8	14	13	16	20	16
2018	Circuit1642	23	8	7	13	19	10	12	14
2018	Circuit1647	39	8	34	27	23	17	22	21
2018	Circuit1643	13	4	22	13	25	11	6	14
2018	Circuit1648	23	22	21	22	24	25	10	20
2018	Circuit1644	17	27	35	26	23	28	16	22
2018	Circuit1645	10	9	16	12	14	13	10	12
2018	Circuit1649	17	5	18	13	8	17	11	12
2018	Circuit55	18	22	31	24	25	24	15	21
2018	Circuit57	3	8	15	9	12	5	8	8
2018	Circuit59	9	10	11	10	11	7	6	8
2018	Circuit60	17	22	29	23	22	17	23	21
2018	Circuit62	18	6	20	15	18	16	12	15
2018	Circuit63	17	16	70	34	58	23	24	35
2018	Circuit64	28	12	27	22	24	26	18	23
2018	Circuit4093	0	0	0	0	0	0	0	0
2018	Circuit3578	10	8	9	9	0	0	0	0
2018	Circuit1663	2	4	5	4	6	4	3	4
2018	Circuit1664	4	6	9	6	7	5	6	6
2018	Circuit1665	2	4	14	7	3	2	9	5
2018	Circuit1666	16	9	26	17	14	30	9	18
2018	Circuit1668	1	6	14	7	5	9	4	6
2018	Circuit1669	10	10	8	9	7	18	8	11
2018	Circuit852	10	7	28	15	9	24	10	14
2018	Circuit853	4	2	9	5	17	1	4	7
2018	Circuit854	11	14	13	13	21	31	24	25
2018	Circuit855	10	8	28	15	26	9	9	15
2018	Circuit856	0	1	0	0	0	1	0	0
2018	Circuit857	25	13	34	24	36	33	28	32
2018	Circuit858	0	0	1	0	2	1	2	2
2018	Circuit859	1	3	4	3	8	7	12	9
2018	Circuit860	12	13	17	14	39	34	17	30
2018	Circuit861	11	9	22	14	20	14	8	14
2018	Circuit862	5	3	12	7	9	7	11	9
2018	Circuit863	6	1	4	4	19	9	11	13

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit864	6	0	3	3	7	5	2	5
2018	Circuit865	11	5	27	14	23	24	10	19
2018	Circuit3742	0	0	0	0	0	0	0	0
2018	Circuit3739	0	0	0	0	0	0	0	0
2018	Circuit1684	1	2	4	2	0	4	13	6
2018	Circuit1685	4	7	17	9	5	5	24	11
2018	Circuit1686	7	17	10	11	13	15	34	21
2018	Circuit1687	0	0	9	3	4	1	10	5
2018	Circuit1688	14	3	7	8	18	16	11	15
2018	Circuit2729	0	0	0	0	1	0	0	0
2018	Circuit2730	0	0	0	0	0	0	0	0
2018	Circuit2731	0	0	1	0	0	0	0	0
2018	Circuit2732	0	0	0	0	1	0	0	0
2018	Circuit2733	0	0	0	0	0	1	3	1
2018	Circuit2734	2	0	8	3	4	4	7	5
2018	Circuit2737	11	13	14	13	10	16	17	14
2018	Circuit2738	3	5	16	8	7	5	11	8
2018	Circuit2739	4	3	18	8	16	18	19	18
2018	Circuit2740	9	11	34	18	5	12	13	10
2018	Circuit2741	4	6	7	6	7	9	6	7
2018	Circuit2742	11	11	24	15	13	24	22	20
2018	Circuit2744	4	1	17	7	22	7	28	19
2018	Circuit2745	2	1	7	3	6	7	15	9
2018	Circuit2746	4	0	1	2	7	8	14	10
2018	Circuit2752	2	2	16	7	12	12	18	14
2018	Circuit2753	8	5	5	6	11	6	10	9
2018	Circuit2754	5	6	12	8	16	9	7	11
2018	Circuit2755	5	1	11	6	3	5	14	7
2018	Circuit2756	2	3	6	4	2	2	8	4
2018	Circuit4087	0	0	0	0	0	0	0	0
2018	Circuit875	7	7	9	8	9	12	22	14
2018	Circuit876	4	9	29	14	14	25	23	21
2018	Circuit3712	1	0	0	0	0	0	0	0
2018	Circuit3641	0	0	0	0	0	0	0	0
2018	Circuit1698	8	6	20	11	10	8	18	12
2018	Circuit3587	9	1	10	7	4	0	0	1
2018	Circuit1699	13	15	11	13	12	11	7	10
2018	Circuit1700	19	14	19	17	14	2	14	10
2018	Circuit1701	7	11	12	10	6	0	0	2
2018	Circuit3588	11	8	11	10	10	0	0	3
2018	Circuit2056	0	0	1	0	0	0	1	0
2018	Circuit2057	0	0	0	0	0	0	0	0
2018	Circuit2058	0	0	0	0	0	0	0	0
2018	Circuit2059	5	2	11	6	14	4	0	6
2018	Circuit2060	4	14	10	9	4	2	4	3

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2061	5	8	14	9	20	9	4	11
2018	Circuit2062	4	7	5	5	5	1	3	3
2018	Circuit4088	1	0	0	0	0	0	0	0
2018	Circuit1702	12	7	14	11	13	11	13	12
2018	Circuit1703	11	29	11	17	16	16	20	17
2018	Circuit1704	20	23	58	34	20	20	21	20
2018	Circuit2790	3	7	5	5	7	9	22	13
2018	Circuit2791	2	7	17	9	4	15	15	11
2018	Circuit2792	6	8	16	10	21	12	24	19
2018	Circuit2794	3	4	13	7	7	10	25	14
2018	Circuit2795	0	0	0	0	0	1	0	0
2018	Circuit2796	0	0	1	0	0	0	0	0
2018	Circuit2798	0	0	0	0	0	0	0	0
2018	Circuit2801	2	1	14	6	3	4	6	4
2018	Circuit2802	0	0	1	0	1	1	0	1
2018	Circuit2803	0	0	0	0	1	1	0	1
2018	Circuit2804	5	2	4	4	7	6	6	6
2018	Circuit2805	1	0	6	2	9	16	11	12
2018	Circuit2806	0	0	3	1	3	0	9	4
2018	Circuit2807	2	5	5	4	2	9	4	5
2018	Circuit2808	7	3	6	5	7	7	13	9
2018	Circuit2810	0	0	0	0	0	1	1	1
2018	Circuit879	0	2	1	1	0	0	0	0
2018	Circuit880	1	0	0	0	0	0	0	0
2018	Circuit881	0	0	0	0	0	0	0	0
2018	Circuit882	1	0	1	1	0	0	1	0
2018	Circuit883	0	0	0	0	0	2	0	1
2018	Circuit884	2	0	0	1	0	0	0	0
2018	Circuit886	0	1	0	0	0	1	0	0
2018	Circuit887	3	3	6	4	10	6	18	11
2018	Circuit888	2	5	4	4	3	5	2	3
2018	Circuit889	12	11	21	15	19	31	47	32
2018	Circuit892	8	4	18	10	25	9	14	16
2018	Circuit893	5	5	7	6	11	8	9	9
2018	Circuit2063	4	17	7	9	4	13	8	8
2018	Circuit3745	0	0	0	0	0	0	0	0
2018	Circuit2066	0	0	0	0	0	0	0	0
2018	Circuit2067	0	2	3	2	3	2	6	4
2018	Circuit2068	6	9	33	16	25	18	71	38
2018	Circuit2069	5	4	8	6	14	4	14	11
2018	Circuit2070	3	2	12	6	9	7	35	17
2018	Circuit2071	7	2	5	5	5	8	16	10
2018	Circuit2072	1	2	8	4	3	7	6	5
2018	Circuit3740	0	0	0	0	0	0	0	0
2018	Circuit2076	4	3	10	6	2	4	3	3

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2077	3	3	10	5	12	0	8	7
2018	Circuit2078	4	4	11	6	13	4	9	9
2018	Circuit2079	0	0	0	0	0	0	0	0
2018	Circuit2080	5	4	5	5	9	4	9	7
2018	Circuit2081	2	2	3	2	7	3	0	3
2018	Circuit2082	6	10	12	9	9	8	8	8
2018	Circuit895	0	0	0	0	2	0	1	1
2018	Circuit3622	0	0	0	0	0	0	0	0
2018	Circuit3643	0	0	0	0	0	0	0	0
2018	Circuit896	0	0	0	0	0	1	0	0
2018	Circuit3623	0	0	0	0	0	0	0	0
2018	Circuit897	0	1	1	1	1	0	0	0
2018	Circuit898	1	0	1	1	0	0	0	0
2018	Circuit901	1	1	5	2	0	2	2	1
2018	Circuit903	5	4	6	5	7	5	14	9
2018	Circuit904	12	12	16	13	30	12	19	20
2018	Circuit1708	11	11	28	17	32	19	17	23
2018	Circuit1713	27	5	36	23	34	14	14	21
2018	Circuit1709	7	4	19	10	2	9	13	8
2018	Circuit1712	0	0	2	1	2	1	5	3
2018	Circuit1715	9	7	19	12	9	18	20	16
2018	Circuit2083	6	7	12	8	15	10	1	9
2018	Circuit2084	5	27	14	15	7	8	11	9
2018	Circuit2085	19	10	15	15	10	14	7	10
2018	Circuit2086	0	0	0	0	0	0	0	0
2018	Circuit2087	3	0	3	2	7	7	25	13
2018	Circuit2088	25	16	28	23	15	9	2	9
2018	Circuit910	0	0	0	0	0	0	0	0
2018	Circuit911	0	0	0	0	2	1	0	1
2018	Circuit912	4	3	5	4	2	5	3	3
2018	Circuit913	6	8	4	6	20	5	9	11
2018	Circuit916	4	4	7	5	11	2	5	6
2018	Circuit919	12	17	27	19	19	9	26	18
2018	Circuit3744	0	0	0	0	0	0	0	0
2018	Circuit1717	0	0	0	0	0	0	0	0
2018	Circuit1719	0	0	0	0	0	0	0	0
2018	Circuit1721	0	0	0	0	0	0	0	0
2018	Circuit1726	0	0	0	0	0	0	0	0
2018	Circuit1727	0	3	1	1	0	0	2	1
2018	Circuit1728	1	0	1	1	0	0	0	0
2018	Circuit1729	1	0	0	0	0	0	0	0
2018	Circuit1730	1	0	1	1	0	0	0	0
2018	Circuit1732	8	7	24	13	18	15	12	15
2018	Circuit1733	2	6	13	7	13	20	17	17
2018	Circuit1734	13	10	7	10	17	33	15	22

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1735	8	8	4	7	5	9	22	12
2018	Circuit1736	20	9	8	12	26	18	26	23
2018	Circuit1737	9	9	16	11	12	18	14	15
2018	Circuit1738	6	6	42	18	23	26	24	24
2018	Circuit1739	15	9	14	13	20	9	12	14
2018	Circuit4094	0	1	0	0	0	0	0	0
2018	Circuit933	6	12	5	8	6	5	5	5
2018	Circuit934	11	11	19	14	10	17	5	11
2018	Circuit935	11	11	25	16	17	22	20	20
2018	Circuit936	4	4	29	12	9	11	6	9
2018	Circuit937	9	23	26	19	23	25	19	22
2018	Circuit938	18	8	35	20	8	22	19	16
2018	Circuit939	6	18	6	10	20	11	7	13
2018	Circuit2859	3	7	7	6	3	7	10	7
2018	Circuit1401	1	4	4	3	7	2	10	6
2018	Circuit1402	6	5	8	6	12	3	12	9
2018	Circuit3644	0	0	0	0	0	0	0	0
2018	Circuit2862	0	1	0	0	0	1	2	1
2018	Circuit2863	0	3	1	1	1	1	2	1
2018	Circuit2864	2	4	2	3	2	1	7	3
2018	Circuit2865	6	13	20	13	14	22	18	18
2018	Circuit2866	7	10	11	9	30	13	25	23
2018	Circuit2867	0	0	0	0	0	0	0	0
2018	Circuit2868	11	11	12	11	22	32	22	25
2018	Circuit2869	3	5	8	5	14	4	17	12
2018	Circuit2870	17	7	39	21	29	31	30	30
2018	Circuit2877	0	0	8	3	0	11	10	7
2018	Circuit2878	0	0	0	0	0	0	0	0
2018	Circuit2879	2	1	2	2	1	2	9	4
2018	Circuit2881	7	1	1	3	1	0	3	1
2018	Circuit2882	0	1	3	1	3	3	2	3
2018	Circuit2884	3	1	3	2	5	3	2	3
2018	Circuit2885	2	0	5	2	1	3	10	5
2018	Circuit2886	6	3	11	7	8	6	4	6
2018	Circuit2887	3	1	9	4	9	4	4	6
2018	Circuit2888	0	0	1	0	3	3	6	4
2018	Circuit2889	4	6	5	5	11	2	14	9
2018	Circuit2890	0	3	10	4	13	8	9	10
2018	Circuit2894	6	8	4	6	7	5	12	8
2018	Circuit2895	2	2	7	4	7	7	9	8
2018	Circuit1740	0	0	0	0	0	0	0	0
2018	Circuit1741	16	9	16	14	16	5	9	10
2018	Circuit1743	33	37	82	51	41	27	40	36
2018	Circuit1744	0	0	0	0	1	0	0	0
2018	Circuit1745	10	9	5	8	10	9	8	9

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1746	14	10	23	16	16	11	23	17
2018	Circuit1748	5	5	19	10	10	9	10	10
2018	Circuit1749	16	8	25	16	15	13	33	20
2018	Circuit1750	16	15	11	14	15	23	17	18
2018	Circuit1751	10	7	16	11	12	7	15	11
2018	Circuit3727	0	0	0	0	0	0	0	0
2018	Circuit3590	3	0	1	1	1	0	0	0
2018	Circuit3591	0	0	1	0	0	0	0	0
2018	Circuit3592	10	11	4	8	7	0	0	2
2018	Circuit3594	8	7	4	6	1	0	0	0
2018	Circuit3595	8	8	21	12	5	0	0	2
2018	Circuit1752	5	1	12	6	6	3	13	7
2018	Circuit1753	3	3	7	4	2	3	7	4
2018	Circuit1759	6	3	15	8	2	6	11	6
2018	Circuit1754	3	2	3	3	5	3	31	13
2018	Circuit1755	7	2	2	4	1	1	10	4
2018	Circuit1756	5	1	7	4	6	5	13	8
2018	Circuit3646	0	0	0	0	0	0	0	0
2018	Circuit940	0	0	0	0	0	0	0	0
2018	Circuit941	1	4	3	3	1	1	0	1
2018	Circuit942	0	0	0	0	3	0	0	1
2018	Circuit943	2	3	9	5	6	3	8	6
2018	Circuit2931	0	0	0	0	0	0	0	0
2018	Circuit2932	9	9	6	8	7	8	21	12
2018	Circuit2933	22	16	11	16	15	14	26	18
2018	Circuit2934	12	3	32	16	11	23	22	19
2018	Circuit2935	16	15	23	18	16	23	25	21
2018	Circuit2936	0	2	3	2	5	6	6	6
2018	Circuit2937	4	1	7	4	3	4	3	3
2018	Circuit1764	0	0	0	0	0	0	0	0
2018	Circuit1250	0	0	0	0	1	2	2	2
2018	Circuit1252	8	1	5	5	5	3	10	6
2018	Circuit1253	16	4	15	12	17	11	15	14
2018	Circuit1255	9	2	10	7	8	8	10	9
2018	Circuit1256	10	7	24	14	14	7	13	11
2018	Circuit1257	0	2	0	1	1	1	1	1
2018	Circuit944	6	2	7	5	8	10	8	9
2018	Circuit945	1	0	0	0	1	0	0	0
2018	Circuit946	3	3	3	3	9	5	4	6
2018	Circuit947	5	3	1	3	2	2	0	1
2018	Circuit3651	0	0	0	0	0	0	0	0
2018	Circuit1766	0	12	9	7	0	1	2	1
2018	Circuit1768	4	7	1	4	2	0	13	5
2018	Circuit1769	5	3	7	5	2	2	6	3
2018	Circuit1771	0	0	1	0	0	0	0	0

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1772	1	1	1	1	6	9	1	5
2018	Circuit1773	3	1	36	13	7	11	17	12
2018	Circuit1774	3	8	23	11	9	7	10	9
2018	Circuit2971	8	9	24	14	12	13	16	14
2018	Circuit2973	5	8	10	8	6	19	10	12
2018	Circuit948	0	0	0	0	2	1	0	1
2018	Circuit950	4	8	9	7	16	5	6	9
2018	Circuit951	15	22	27	21	17	13	26	19
2018	Circuit952	6	16	29	17	16	14	9	13
2018	Circuit953	14	7	16	12	11	9	17	12
2018	Circuit954	21	18	25	21	38	28	21	29
2018	Circuit955	7	20	24	17	25	23	26	25
2018	Circuit4089	0	0	0	0	0	0	0	0
2018	Circuit2993	0	0	1	0	0	1	1	1
2018	Circuit2994	2	1	1	1	1	0	1	1
2018	Circuit2995	5	4	15	8	11	16	28	18
2018	Circuit2996	5	3	5	4	15	11	24	17
2018	Circuit2997	2	7	13	7	10	15	14	13
2018	Circuit2998	12	14	12	13	11	3	9	8
2018	Circuit2999	1	4	9	5	15	2	5	7
2018	Circuit3737	0	0	0	0	0	0	0	0
2018	Circuit957	6	1	5	4	18	7	6	10
2018	Circuit958	6	5	8	6	16	0	0	5
2018	Circuit959	0	1	0	0	0	0	1	0
2018	Circuit960	14	4	17	12	28	15	22	22
2018	Circuit3598	0	0	0	0	0	0	0	0
2018	Circuit3041	1	1	3	2	2	0	5	2
2018	Circuit3056	1	2	1	1	1	1	0	1
2018	Circuit3064	4	10	3	6	2	4	11	6
2018	Circuit3065	8	17	32	19	11	0	0	4
2018	Circuit3066	5	5	21	10	15	11	21	16
2018	Circuit3068	0	0	0	0	0	0	0	0
2018	Circuit3069	0	0	2	1	1	0	0	0
2018	Circuit1779	5	10	10	8	9	0	0	3
2018	Circuit3070	2	2	7	4	4	4	14	7
2018	Circuit3071	5	3	10	6	7	16	29	17
2018	Circuit3072	1	1	6	3	5	9	14	9
2018	Circuit3073	8	4	10	7	6	8	13	9
2018	Circuit3074	6	0	14	7	11	14	17	14
2018	Circuit1780	6	2	1	3	4	1	7	4
2018	Circuit1781	0	1	0	0	0	0	0	0
2018	Circuit1782	1	2	3	2	2	1	3	2
2018	Circuit1783	1	1	0	1	3	1	0	1
2018	Circuit1785	2	2	3	2	1	0	1	1
2018	Circuit1786	0	0	0	0	0	0	0	0

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1788	0	0	0	0	0	1	0	0
2018	Circuit1789	8	8	9	8	30	18	24	24
2018	Circuit1790	6	13	33	17	13	16	14	14
2018	Circuit1791	2	2	2	2	10	11	8	10
2018	Circuit1792	17	31	47	32	30	30	38	33
2018	Circuit1793	5	5	2	4	3	13	9	8
2018	Circuit1794	28	5	12	15	19	11	25	18
2018	Circuit1795	2	2	0	1	1	3	3	2
2018	Circuit3657	0	1	0	0	0	0	0	0
2018	Circuit3658	0	0	0	0	0	0	0	0
2018	Circuit3606	0	1	1	1	2	1	0	1
2018	Circuit3607	2	0	1	1	0	1	0	0
2018	Circuit3608	0	1	0	0	0	0	0	0
2018	Circuit3609	0	0	1	0	0	2	3	2
2018	Circuit3659	0	0	0	0	0	0	0	0
2018	Circuit3661	0	0	0	0	0	0	0	0
2018	Circuit3713	12	0	0	4	0	0	0	0
2018	Circuit3662	0	0	0	0	1	0	0	0
2018	Circuit3663	5	0	1	2	0	0	0	0
2018	Circuit3611	2	6	3	4	5	2	0	2
2018	Circuit3714	4	0	0	1	0	0	0	0
2018	Circuit3094	0	0	1	0	0	0	0	0
2018	Circuit3096	0	0	0	0	2	2	3	2
2018	Circuit3097	13	10	8	10	21	17	47	28
2018	Circuit3099	14	9	17	13	11	24	28	21
2018	Circuit3747	0	0	0	0	0	0	0	0
2018	Circuit3100	4	5	19	9	20	19	44	28
2018	Circuit3101	9	5	18	11	22	14	30	22
2018	Circuit3102	8	3	7	6	12	18	8	13
2018	Circuit3758	2	1	0	1	0	0	0	0
2018	Circuit1798	17	3	27	16	22	18	20	20
2018	Circuit1799	10	8	30	16	25	18	37	27
2018	Circuit1800	12	6	15	11	18	21	24	21
2018	Circuit1801	10	8	16	11	15	12	14	14
2018	Circuit1802	16	10	13	13	14	15	20	16
2018	Circuit1803	0	2	2	1	1	1	1	1
2018	Circuit1804	12	9	8	10	18	14	30	21
2018	Circuit1805	0	1	0	0	1	1	0	1
2018	Circuit1806	0	2	0	1	0	0	1	0
2018	Circuit1807	0	0	1	0	0	0	0	0
2018	Circuit1809	3	3	3	3	4	2	15	7
2018	Circuit3124	0	1	0	0	0	0	0	0
2018	Circuit3126	1	2	4	2	0	1	1	1
2018	Circuit3131	14	13	17	15	25	21	21	22
2018	Circuit4090	0	0	0	0	0	0	0	0

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1812	0	3	4	2	2	0	5	2
2018	Circuit1815	0	1	1	1	0	1	1	1
2018	Circuit1816	0	1	0	0	0	0	0	0
2018	Circuit1817	0	0	0	0	0	0	0	0
2018	Circuit3667	0	0	0	0	0	0	0	0
2018	Circuit1818	1	0	2	1	0	0	2	1
2018	Circuit1819	0	1	1	1	3	1	2	2
2018	Circuit1820	11	8	21	13	4	6	20	10
2018	Circuit1821	6	2	16	8	15	7	5	9
2018	Circuit1822	2	3	12	6	6	4	4	5
2018	Circuit1823	8	11	9	9	7	5	16	9
2018	Circuit1824	21	23	23	22	36	38	48	41
2018	Circuit1825	3	6	18	9	17	20	10	16
2018	Circuit1826	1	4	4	3	8	2	11	7
2018	Circuit3156	0	0	0	0	0	0	1	0
2018	Circuit1265	2	4	0	2	2	0	0	1
2018	Circuit1266	0	0	0	0	0	0	1	0
2018	Circuit1268	0	0	0	0	0	0	0	0
2018	Circuit1269	0	0	0	0	0	0	0	0
2018	Circuit1271	0	0	2	1	0	3	0	1
2018	Circuit1272	0	0	0	0	0	0	0	0
2018	Circuit1274	27	6	16	16	22	22	16	20
2018	Circuit1275	5	5	11	7	16	6	16	13
2018	Circuit1276	5	2	4	4	6	5	10	7
2018	Circuit1827	3	1	4	3	2	6	2	3
2018	Circuit1828	3	9	3	5	7	11	17	12
2018	Circuit1829	7	4	2	4	6	10	8	8
2018	Circuit1830	4	4	8	5	11	5	14	10
2018	Circuit3184	0	3	2	2	0	1	3	1
2018	Circuit3185	1	2	1	1	5	1	7	4
2018	Circuit3186	4	6	17	9	23	19	22	21
2018	Circuit3187	4	5	11	7	6	13	22	14
2018	Circuit3188	0	2	2	1	11	7	15	11
2018	Circuit3189	0	0	0	0	0	0	0	0
2018	Circuit3190	3	7	4	5	4	1	14	6
2018	Circuit3192	3	4	12	6	11	6	21	13
2018	Circuit3193	0	2	4	2	2	7	12	7
2018	Circuit3194	3	7	8	6	10	9	11	10
2018	Circuit3195	2	7	5	5	10	6	21	12
2018	Circuit1839	11	3	6	7	3	17	7	9
2018	Circuit1845	0	3	2	2	14	2	12	9
2018	Circuit1846	5	1	4	3	2	3	4	3
2018	Circuit1847	0	0	0	0	0	0	0	0
2018	Circuit1848	0	3	10	4	7	5	11	8
2018	Circuit1849	4	4	5	4	11	2	2	5

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1850	1	0	0	0	2	0	1	1
2018	Circuit1851	0	2	6	3	8	5	4	6
2018	Circuit1852	0	0	0	0	1	1	0	1
2018	Circuit1853	0	0	1	0	2	4	12	6
2018	Circuit1854	6	2	4	4	17	1	2	7
2018	Circuit3752	0	1	2	1	0	0	0	0
2018	Circuit1433	5	4	4	4	2	3	4	3
2018	Circuit1434	1	2	10	4	8	6	7	7
2018	Circuit1435	3	10	5	6	10	4	6	7
2018	Circuit1436	2	2	1	2	1	5	3	3
2018	Circuit2145	4	1	13	6	2	1	19	7
2018	Circuit2146	10	3	16	10	5	14	31	17
2018	Circuit2147	0	6	15	7	3	4	32	13
2018	Circuit1300	10	4	8	7	4	12	7	8
2018	Circuit1301	17	7	8	11	9	3	16	9
2018	Circuit1302	13	5	7	8	10	3	18	10
2018	Circuit1303	7	8	10	8	6	13	11	10
2018	Circuit1295	8	3	7	6	7	7	3	6
2018	Circuit1297	3	1	3	2	1	2	1	1
2018	Circuit1304	19	12	13	15	17	11	23	17
2018	Circuit1306	15	6	4	8	6	11	12	10
2018	Circuit1298	4	3	2	3	5	1	5	4
2018	Circuit3735	1	0	0	0	0	0	0	0
2018	Circuit975	1	1	0	1	0	1	2	1
2018	Circuit978	9	0	0	3	0	0	1	0
2018	Circuit979	0	0	0	0	0	0	1	0
2018	Circuit980	0	0	1	0	3	0	0	1
2018	Circuit3677	0	0	0	0	0	0	0	0
2018	Circuit981	0	0	0	0	0	0	0	0
2018	Circuit982	0	0	0	0	1	0	0	0
2018	Circuit983	0	0	0	0	1	0	0	0
2018	Circuit986	0	0	1	0	1	1	0	1
2018	Circuit987	2	0	0	1	6	4	1	4
2018	Circuit988	9	4	12	8	6	8	8	7
2018	Circuit989	15	3	25	14	14	12	18	15
2018	Circuit991	7	8	16	10	17	17	13	16
2018	Circuit992	2	2	5	3	7	8	5	7
2018	Circuit994	28	24	31	28	22	26	13	20
2018	Circuit995	14	14	15	14	17	5	10	11
2018	Circuit3303	0	0	0	0	0	0	0	0
2018	Circuit1877	0	0	0	0	0	0	0	0
2018	Circuit1878	8	5	17	10	13	13	10	12
2018	Circuit1879	2	1	2	2	2	0	2	1
2018	Circuit1880	9	6	16	10	18	18	34	23
2018	Circuit2150	14	15	20	16	17	12	31	20

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3314	0	1	0	0	0	0	0	0
2018	Circuit3315	0	0	0	0	0	0	0	0
2018	Circuit3316	1	5	0	2	2	5	5	4
2018	Circuit3317	4	3	6	4	6	9	10	8
2018	Circuit3318	5	4	5	5	2	4	3	3
2018	Circuit3319	2	4	4	3	12	7	7	9
2018	Circuit3320	7	8	5	7	6	11	15	11
2018	Circuit3321	1	6	13	7	7	7	9	8
2018	Circuit3322	5	3	0	3	1	7	8	5
2018	Circuit3323	6	0	1	2	3	14	9	9
2018	Circuit3324	4	2	3	3	12	4	8	8
2018	Circuit3757	0	0	0	0	0	0	0	0
2018	Circuit1455	0	0	0	0	0	0	0	0
2018	Circuit2167	10	8	9	9	3	3	13	6
2018	Circuit2165	1	3	11	5	9	3	5	6
2018	Circuit2166	7	1	10	6	8	3	20	10
2018	Circuit1307	0	2	1	1	0	1	0	0
2018	Circuit1308	1	1	0	1	0	0	1	0
2018	Circuit1309	0	0	2	1	0	0	3	1
2018	Circuit1310	0	1	0	0	2	0	1	1
2018	Circuit1311	0	0	0	0	2	2	5	3
2018	Circuit1312	0	0	0	0	0	0	0	0
2018	Circuit1313	2	3	1	2	8	1	7	5
2018	Circuit1314	0	0	0	0	0	0	0	0
2018	Circuit3395	14	13	16	14	16	20	53	30
2018	Circuit3397	0	0	1	0	6	0	5	4
2018	Circuit3398	2	6	3	4	3	5	6	5
2018	Circuit3399	0	0	0	0	0	0	0	0
2018	Circuit3400	5	5	4	5	10	11	15	12
2018	Circuit1458	0	3	7	3	4	0	5	3
2018	Circuit1459	4	7	6	6	3	2	4	3
2018	Circuit1460	4	2	7	4	2	1	7	3
2018	Circuit1461	0	0	0	0	0	0	0	0
2018	Circuit1462	1	2	1	1	2	0	3	2
2018	Circuit1463	5	0	4	3	2	2	4	3
2018	Circuit1464	5	1	1	2	4	0	13	6
2018	Circuit3724	0	0	0	0	0	0	0	0
2018	Circuit1907	0	0	0	0	0	0	0	0
2018	Circuit1908	0	0	0	0	0	2	0	1
2018	Circuit1910	12	4	3	6	7	4	10	7
2018	Circuit1912	8	11	14	11	8	4	19	10
2018	Circuit1916	0	0	0	0	0	0	0	0
2018	Circuit1917	0	0	0	0	0	0	0	0
2018	Circuit1918	2	4	17	8	15	16	10	14
2018	Circuit1919	8	8	3	6	18	0	8	9

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1920	0	0	0	0	0	0	0	0
2018	Circuit1921	20	15	19	18	20	19	15	18
2018	Circuit1922	14	13	14	14	15	26	20	20
2018	Circuit1923	0	0	0	0	0	0	0	0
2018	Circuit1924	6	7	20	11	13	12	8	11
2018	Circuit1925	6	13	27	15	15	14	9	13
2018	Circuit1926	0	0	0	0	2	0	1	1
2018	Circuit1009	8	1	7	5	7	27	13	16
2018	Circuit1010	7	6	7	7	10	8	18	12
2018	Circuit1011	2	0	4	2	7	29	9	15
2018	Circuit1012	4	8	23	12	13	6	5	8
2018	Circuit1013	4	0	8	4	12	7	12	10
2018	Circuit1014	2	3	10	5	11	22	12	15
2018	Circuit1016	4	3	4	4	17	10	17	15
2018	Circuit1017	12	1	3	5	8	16	15	13
2018	Circuit1018	1	0	3	1	7	7	8	7
2018	Circuit1019	1	13	26	13	14	46	9	23
2018	Circuit1022	8	6	32	15	15	23	25	21
2018	Circuit1023	6	4	7	6	5	7	4	5
2018	Circuit3732	0	0	0	0	0	0	0	0
2018	Circuit1927	2	1	2	2	1	0	0	0
2018	Circuit1928	6	4	2	4	4	14	2	7
2018	Circuit1936	0	0	1	0	1	0	1	1
2018	Circuit1938	1	0	1	1	1	0	1	1
2018	Circuit1939	8	6	23	12	21	16	14	17
2018	Circuit1940	27	14	39	27	17	10	14	14
2018	Circuit1941	22	14	24	20	17	23	34	25
2018	Circuit1024	0	0	2	1	1	4	1	2
2018	Circuit1026	0	0	0	0	0	0	0	0
2018	Circuit1028	0	0	1	0	0	1	1	1
2018	Circuit1029	0	2	0	1	2	1	0	1
2018	Circuit1030	0	0	0	0	0	1	2	1
2018	Circuit1031	0	0	1	0	1	0	0	0
2018	Circuit1032	1	0	0	0	6	0	0	2
2018	Circuit1033	1	0	1	1	0	1	0	0
2018	Circuit1034	0	0	1	0	1	1	1	1
2018	Circuit1038	4	3	6	4	9	15	7	10
2018	Circuit1037	0	0	0	0	0	2	0	1
2018	Circuit3746	0	0	0	0	0	0	0	0
2018	Circuit3729	0	0	0	0	0	0	0	0
2018	Circuit3484	0	1	0	0	1	2	3	2
2018	Circuit3722	1	1	0	1	0	0	0	0
2018	Circuit3486	1	1	0	1	1	0	1	1
2018	Circuit3487	0	0	1	0	2	1	3	2
2018	Circuit3488	0	0	0	0	0	0	0	0

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3489	0	0	3	1	8	14	34	19
2018	Circuit3490	0	0	3	1	9	17	21	16
2018	Circuit3690	8	3	1	4	0	0	0	0
2018	Circuit3491	7	8	9	8	16	21	19	19
2018	Circuit3492	1	1	8	3	4	5	11	7
2018	Circuit3493	4	5	9	6	22	12	16	17
2018	Circuit3494	0	0	0	0	0	0	0	0
2018	Circuit3495	5	3	8	5	5	13	19	12
2018	Circuit3496	3	7	6	5	10	1	9	7
2018	Circuit3497	4	0	8	4	2	2	11	5
2018	Circuit3498	5	9	13	9	10	23	17	17
2018	Circuit3499	15	3	20	13	8	8	21	12
2018	Circuit3501	10	4	19	11	4	12	18	11
2018	Circuit3502	4	12	13	10	14	21	14	16
2018	Circuit3503	1	6	8	5	7	28	12	16
2018	Circuit3509	4	2	14	7	23	6	7	12
2018	Circuit3510	14	16	7	12	11	16	30	19
2018	Circuit3511	0	2	5	2	1	4	16	7
2018	Circuit3513	0	0	1	0	0	1	1	1
2018	Circuit3723	0	0	1	0	1	0	0	0
2018	Circuit3535	0	0	0	0	0	0	0	0
2018	Circuit3686	6	1	1	3	0	0	0	0
2018	Circuit3536	0	0	0	0	2	2	0	1
2018	Circuit3687	0	1	2	1	0	0	0	0
2018	Circuit3537	0	1	1	1	2	3	1	2
2018	Circuit3688	1	0	0	0	0	0	0	0
2018	Circuit3619	6	5	21	11	9	0	0	3
2018	Circuit3621	9	23	43	25	18	0	0	6
2018	Circuit1047	5	7	42	18	13	14	6	11
2018	Circuit1048	16	15	28	20	14	15	15	15
2018	Circuit2376	0	0	0	0	0	12	16	9
2018	Circuit1049	14	19	32	22	8	20	9	12
2018	Circuit2377	0	0	0	0	4	22	29	18
2018	Circuit2378	0	0	0	0	1	19	21	14
2018	Circuit2679	0	0	0	0	0	1	1	1
2018	Circuit2681	0	0	0	0	0	14	18	11
2019	Circuit206	1	14	11	9	1	3	7	4
2019	Circuit208	4	5	3	4	2	6	2	3
2019	Circuit211	12	23	13	16	10	9	18	12
2019	Circuit2434	2	3	7	4	9	4	12	8
2019	Circuit2436	4	8	9	7	7	4	11	7
2019	Circuit2438	0	5	1	2	3	1	1	2
2019	Circuit2439	4	13	5	7	8	6	9	8
2019	Circuit3624	0	0	0	0	0	0	0	0
2019	Circuit2441	0	0	0	0	0	0	3	1

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit2442	10	5	15	10	7	15	18	13
2019	Circuit2443	3	14	14	10	8	9	13	10
2019	Circuit2444	10	6	5	7	10	7	14	10
2019	Circuit2445	1	9	4	5	2	7	21	10
2019	Circuit2446	2	7	4	4	11	6	12	10
2019	Circuit2447	3	13	10	9	4	13	32	16
2019	Circuit4092	0	0	0	0	0	0	0	0
2019	Circuit3625	0	0	0	0	0	0	0	0
2019	Circuit2455	1	4	1	2	0	0	1	0
2019	Circuit2460	0	1	0	0	2	2	1	2
2019	Circuit2466	0	1	0	0	0	0	0	0
2019	Circuit2472	1	6	2	3	2	4	3	3
2019	Circuit2473	0	5	7	4	6	2	5	4
2019	Circuit2474	1	1	3	2	6	2	1	3
2019	Circuit1595	0	0	0	0	0	0	0	0
2019	Circuit1596	2	2	0	1	1	0	2	1
2019	Circuit1597	1	2	2	2	3	1	1	2
2019	Circuit1598	8	25	50	28	19	26	20	22
2019	Circuit1599	3	8	6	6	11	14	4	10
2019	Circuit1600	10	7	15	11	10	13	18	14
2019	Circuit1601	6	33	18	19	24	17	6	16
2019	Circuit1602	3	8	8	6	5	11	14	10
2019	Circuit1603	3	8	16	9	3	7	2	4
2019	Circuit1604	16	5	25	15	5	7	6	6
2019	Circuit1605	13	16	40	23	24	26	18	23
2019	Circuit1606	16	18	41	25	11	19	21	17
2019	Circuit1607	9	22	24	18	11	22	25	19
2019	Circuit3741	0	0	0	0	0	0	0	0
2019	Circuit2015	0	1	0	0	0	0	0	0
2019	Circuit2016	2	15	5	7	4	1	4	3
2019	Circuit2017	1	6	6	4	1	8	3	4
2019	Circuit2527	0	0	0	0	0	0	0	0
2019	Circuit2019	1	1	0	1	1	1	0	1
2019	Circuit2020	1	4	0	2	0	1	3	1
2019	Circuit2021	0	0	0	0	0	0	0	0
2019	Circuit2022	10	15	16	14	10	18	16	15
2019	Circuit2023	4	30	11	15	5	8	9	7
2019	Circuit2024	4	11	4	6	3	9	2	5
2019	Circuit2025	6	11	8	8	9	13	11	11
2019	Circuit3728	0	0	0	0	0	0	0	0
2019	Circuit1629	2	8	3	4	17	17	20	18
2019	Circuit1630	9	21	8	13	10	8	9	9
2019	Circuit1631	2	3	11	5	10	34	11	18
2019	Circuit1632	4	7	10	7	3	9	10	7
2019	Circuit1633	2	17	10	10	5	22	14	14

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit2559	3	10	19	11	6	13	14	11
2019	Circuit1634	5	6	12	8	4	19	6	10
2019	Circuit2566	2	4	5	4	6	11	4	7
2019	Circuit2578	3	17	17	12	13	28	4	15
2019	Circuit2579	5	9	18	11	11	9	3	8
2019	Circuit3730	0	0	0	0	0	0	0	0
2019	Circuit1237	1	1	3	2	1	3	0	1
2019	Circuit1238	0	0	0	0	0	0	0	0
2019	Circuit1239	1	4	2	2	5	17	3	8
2019	Circuit1240	6	1	3	3	0	5	3	3
2019	Circuit1241	0	0	0	0	0	0	0	0
2019	Circuit1242	2	1	3	2	6	3	0	3
2019	Circuit1243	5	11	8	8	10	14	9	11
2019	Circuit1244	3	0	7	3	3	8	11	7
2019	Circuit1245	1	7	6	5	6	5	7	6
2019	Circuit1246	3	3	8	5	7	3	12	7
2019	Circuit3710	0	0	0	0	0	0	0	0
2019	Circuit820	0	1	0	0	0	0	0	0
2019	Circuit825	0	0	0	0	0	0	0	0
2019	Circuit826	0	0	2	1	2	1	1	1
2019	Circuit827	1	3	5	3	4	3	5	4
2019	Circuit828	24	24	23	24	27	25	9	20
2019	Circuit829	21	53	29	34	36	16	16	23
2019	Circuit830	15	18	15	16	14	17	6	12
2019	Circuit831	0	4	3	2	1	0	2	1
2019	Circuit832	12	23	13	16	33	23	12	23
2019	Circuit833	12	8	16	12	22	7	13	14
2019	Circuit834	3	10	9	7	5	13	2	7
2019	Circuit835	13	28	21	21	34	35	25	31
2019	Circuit836	14	12	21	16	13	20	16	16
2019	Circuit837	0	4	8	4	4	2	1	2
2019	Circuit838	14	23	24	20	35	17	26	26
2019	Circuit4093	0	0	0	0	0	0	0	0
2019	Circuit3578	8	9	0	6	0	0	0	0
2019	Circuit1663	4	5	11	7	4	3	4	4
2019	Circuit1664	6	9	12	9	5	6	10	7
2019	Circuit1665	4	14	8	9	2	9	5	5
2019	Circuit1666	9	26	19	18	29	9	27	22
2019	Circuit1668	6	14	15	12	9	4	1	5
2019	Circuit1669	10	8	15	11	17	8	10	12
2019	Circuit852	7	28	9	15	24	10	6	13
2019	Circuit853	2	9	14	8	1	4	4	3
2019	Circuit854	14	13	14	14	31	24	7	21
2019	Circuit856	1	0	0	0	1	0	0	0
2019	Circuit858	0	1	1	1	1	2	0	1

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit859	3	4	14	7	7	12	9	9
2019	Circuit861	9	22	16	16	14	8	15	12
2019	Circuit862	3	12	5	7	7	11	10	9
2019	Circuit863	1	4	9	5	9	11	3	8
2019	Circuit864	0	3	1	1	5	2	4	4
2019	Circuit3742	0	0	0	0	0	0	0	0
2019	Circuit3739	0	0	0	0	0	0	0	0
2019	Circuit1684	2	4	3	3	4	13	6	8
2019	Circuit1685	7	17	9	11	5	24	5	11
2019	Circuit1686	17	10	7	11	15	34	15	21
2019	Circuit1687	0	9	2	4	1	10	3	5
2019	Circuit1688	3	7	7	6	16	11	12	13
2019	Circuit2729	0	0	0	0	0	0	0	0
2019	Circuit2730	0	0	0	0	0	0	1	0
2019	Circuit2731	0	1	0	0	0	0	0	0
2019	Circuit2732	0	0	0	0	0	0	0	0
2019	Circuit2733	0	0	0	0	1	3	1	2
2019	Circuit2734	0	8	2	3	4	7	2	4
2019	Circuit2737	13	14	20	16	16	17	27	20
2019	Circuit2738	5	16	8	10	6	11	8	8
2019	Circuit2739	3	18	8	10	18	19	20	19
2019	Circuit2740	11	34	14	20	12	13	9	11
2019	Circuit2741	6	7	5	6	9	6	5	7
2019	Circuit2742	11	24	31	22	24	22	20	22
2019	Circuit2744	1	17	9	9	7	28	15	17
2019	Circuit2745	1	7	11	6	7	15	6	9
2019	Circuit2746	0	1	17	6	8	14	14	12
2019	Circuit2752	2	16	14	11	12	18	19	16
2019	Circuit2753	5	5	9	6	6	10	2	6
2019	Circuit2754	6	12	8	9	9	7	4	7
2019	Circuit2755	1	11	1	4	5	14	1	7
2019	Circuit2756	3	6	11	7	2	8	0	3
2019	Circuit4087	0	0	0	0	0	0	0	0
2019	Circuit875	7	9	21	12	12	22	9	14
2019	Circuit876	9	29	19	19	25	23	16	21
2019	Circuit3712	0	0	0	0	0	0	0	0
2019	Circuit3641	0	0	0	0	0	0	0	0
2019	Circuit3587	1	10	7	6	0	0	0	0
2019	Circuit1701	11	12	11	11	0	0	0	0
2019	Circuit3588	8	11	8	9	0	0	0	0
2019	Circuit2058	0	0	0	0	0	0	0	0
2019	Circuit2060	14	10	11	12	2	4	10	5
2019	Circuit4088	0	0	0	0	0	0	0	0
2019	Circuit2790	7	5	15	9	9	22	13	15
2019	Circuit2791	7	17	6	10	15	15	9	13

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit2792	8	16	22	15	12	24	18	18
2019	Circuit2794	4	13	15	11	11	25	8	15
2019	Circuit2795	0	0	1	0	1	0	0	0
2019	Circuit2807	5	5	3	4	9	4	3	5
2019	Circuit2808	3	6	5	5	7	13	16	12
2019	Circuit879	2	1	0	1	0	0	0	0
2019	Circuit880	0	0	0	0	0	0	0	0
2019	Circuit881	0	0	0	0	0	0	0	0
2019	Circuit882	0	1	1	1	0	1	0	0
2019	Circuit883	0	0	0	0	2	0	0	1
2019	Circuit884	0	0	2	1	0	0	0	0
2019	Circuit886	1	0	0	0	1	0	0	0
2019	Circuit887	3	6	6	5	6	18	21	15
2019	Circuit888	5	4	1	3	5	2	6	4
2019	Circuit889	11	21	24	19	31	47	26	35
2019	Circuit892	4	18	22	15	9	14	14	12
2019	Circuit893	5	7	5	6	8	9	5	7
2019	Circuit2063	17	7	4	9	13	8	4	8
2019	Circuit3745	0	0	0	0	0	0	0	0
2019	Circuit2066	0	0	0	0	0	0	0	0
2019	Circuit2067	2	3	1	2	2	6	2	3
2019	Circuit2068	9	33	14	19	18	71	13	34
2019	Circuit2069	4	8	9	7	4	14	3	7
2019	Circuit2070	2	12	13	9	7	35	11	18
2019	Circuit2071	2	5	5	4	8	16	3	9
2019	Circuit2072	2	8	4	5	7	6	1	5
2019	Circuit3740	0	0	0	0	0	0	0	0
2019	Circuit895	0	0	0	0	0	1	0	0
2019	Circuit3622	0	0	0	0	0	0	0	0
2019	Circuit3643	0	0	0	0	0	0	0	0
2019	Circuit896	0	0	1	0	1	0	0	0
2019	Circuit3623	0	0	0	0	0	0	0	0
2019	Circuit897	1	1	1	1	0	0	0	0
2019	Circuit898	0	1	0	0	0	0	0	0
2019	Circuit901	1	5	5	4	2	2	0	1
2019	Circuit903	4	6	5	5	5	14	9	9
2019	Circuit904	12	16	16	15	12	19	24	18
2019	Circuit1708	11	28	25	21	19	17	8	15
2019	Circuit1709	4	19	5	9	9	13	2	8
2019	Circuit1712	0	2	0	1	1	5	1	2
2019	Circuit2083	7	12	10	10	0	1	14	5
2019	Circuit2084	27	14	4	15	0	11	1	4
2019	Circuit2085	10	15	18	14	1	7	2	3
2019	Circuit2086	0	0	0	0	0	0	0	0
2019	Circuit2087	0	3	4	2	0	25	12	12

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit2088	16	28	17	20	1	2	5	3
2019	Circuit3744	0	0	0	0	0	0	0	0
2019	Circuit1717	0	0	0	0	0	0	1	0
2019	Circuit1719	0	0	0	0	0	0	0	0
2019	Circuit1721	0	0	0	0	0	0	0	0
2019	Circuit1726	0	0	0	0	0	0	0	0
2019	Circuit1727	3	1	0	1	0	2	2	1
2019	Circuit1728	0	1	0	0	0	0	1	0
2019	Circuit1729	0	0	0	0	0	0	0	0
2019	Circuit1730	0	1	0	0	0	0	0	0
2019	Circuit1732	7	24	9	13	15	12	18	15
2019	Circuit1733	6	13	24	14	20	17	9	15
2019	Circuit1734	10	7	23	13	33	15	10	19
2019	Circuit1735	8	4	27	13	9	22	21	17
2019	Circuit1736	9	8	25	14	18	26	21	22
2019	Circuit1737	9	16	12	12	18	14	9	14
2019	Circuit1738	6	42	40	29	26	24	24	25
2019	Circuit1739	9	14	21	15	9	12	24	15
2019	Circuit4094	1	0	0	0	0	0	0	0
2019	Circuit2859	7	7	14	9	7	10	13	10
2019	Circuit1401	4	4	3	4	2	10	2	5
2019	Circuit1402	5	8	6	6	3	12	0	5
2019	Circuit3644	0	0	0	0	0	0	0	0
2019	Circuit2862	1	0	0	0	1	2	1	1
2019	Circuit2863	3	1	0	1	1	2	0	1
2019	Circuit2864	4	2	2	3	1	7	2	3
2019	Circuit2865	13	20	14	16	22	18	12	17
2019	Circuit2866	10	11	26	16	13	25	19	19
2019	Circuit2867	0	0	0	0	0	0	0	0
2019	Circuit2869	5	8	20	11	4	17	9	10
2019	Circuit2870	7	39	18	21	31	30	20	27
2019	Circuit2877	0	8	5	4	11	10	5	9
2019	Circuit2878	0	0	0	0	0	0	0	0
2019	Circuit2879	1	2	2	2	2	9	2	4
2019	Circuit2881	1	1	1	1	0	3	2	2
2019	Circuit2882	1	3	4	3	3	2	6	4
2019	Circuit2884	1	3	7	4	3	2	3	3
2019	Circuit2885	0	5	7	4	3	10	7	7
2019	Circuit2886	3	11	6	7	6	4	4	5
2019	Circuit2887	1	9	3	4	4	4	15	8
2019	Circuit2888	0	1	1	1	3	6	2	4
2019	Circuit2889	6	5	6	6	2	14	2	6
2019	Circuit2890	3	10	6	6	8	9	14	10
2019	Circuit2895	2	7	8	6	7	9	3	6
2019	Circuit1744	0	0	0	0	0	0	0	0

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3727	0	0	0	0	0	0	0	0
2019	Circuit3590	0	1	0	0	0	0	0	0
2019	Circuit3591	0	1	1	1	0	0	0	0
2019	Circuit3592	11	4	6	7	0	0	0	0
2019	Circuit3594	7	4	8	6	0	0	0	0
2019	Circuit3595	8	21	15	15	0	0	0	0
2019	Circuit1752	1	12	10	8	3	13	1	6
2019	Circuit1753	3	7	5	5	3	7	9	6
2019	Circuit1759	3	15	11	10	6	11	18	12
2019	Circuit1754	2	3	3	3	3	31	8	14
2019	Circuit1755	2	2	10	5	1	10	0	4
2019	Circuit1756	1	7	8	5	5	13	22	13
2019	Circuit3646	0	0	0	0	0	0	0	0
2019	Circuit2931	0	0	0	0	0	0	0	0
2019	Circuit2932	9	6	20	12	8	21	14	14
2019	Circuit2933	16	11	21	16	14	26	27	22
2019	Circuit2934	3	32	25	20	23	22	36	27
2019	Circuit2935	15	23	25	21	23	25	34	27
2019	Circuit2936	2	3	4	3	6	6	4	5
2019	Circuit2937	1	7	10	6	4	3	7	5
2019	Circuit1764	0	0	0	0	0	0	0	0
2019	Circuit1250	0	0	2	1	2	2	1	2
2019	Circuit1252	1	5	1	2	3	10	6	6
2019	Circuit1253	4	15	28	16	11	15	9	12
2019	Circuit1255	2	10	9	7	8	10	10	9
2019	Circuit1256	7	24	23	18	7	13	16	12
2019	Circuit1257	2	0	2	1	1	1	0	1
2019	Circuit944	2	7	6	5	9	8	5	7
2019	Circuit945	0	0	0	0	0	0	1	0
2019	Circuit946	3	3	9	5	2	4	2	3
2019	Circuit947	3	1	1	2	1	0	7	3
2019	Circuit3651	0	0	0	0	0	0	0	0
2019	Circuit1766	12	9	5	9	1	2	4	2
2019	Circuit1768	7	1	2	3	0	13	4	6
2019	Circuit1769	3	7	2	4	2	6	7	5
2019	Circuit1771	0	1	0	0	0	0	0	0
2019	Circuit1772	1	1	13	5	9	1	8	6
2019	Circuit1773	1	36	4	14	11	17	10	13
2019	Circuit1774	8	23	10	14	7	10	1	6
2019	Circuit948	0	0	0	0	1	0	0	0
2019	Circuit950	8	9	7	8	5	6	6	6
2019	Circuit951	22	27	15	21	13	26	14	18
2019	Circuit952	16	29	11	19	13	9	8	10
2019	Circuit953	7	16	13	12	9	17	7	11
2019	Circuit954	18	25	29	24	28	21	11	20

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit955	20	24	28	24	22	26	18	22
2019	Circuit4089	0	0	0	0	0	0	0	0
2019	Circuit2993	0	1	0	0	1	1	1	1
2019	Circuit2994	1	1	0	1	0	1	1	1
2019	Circuit2995	4	15	9	9	16	28	34	26
2019	Circuit2996	3	5	7	5	11	24	14	16
2019	Circuit2997	7	13	5	8	15	14	10	13
2019	Circuit2998	14	12	20	15	3	9	7	6
2019	Circuit2999	4	9	23	12	2	5	6	4
2019	Circuit3737	0	0	0	0	0	0	0	0
2019	Circuit959	1	0	0	0	0	1	0	0
2019	Circuit3598	0	0	1	0	0	0	0	0
2019	Circuit3041	1	3	1	2	0	5	3	3
2019	Circuit3056	2	1	0	1	1	0	0	0
2019	Circuit3064	10	3	7	7	4	11	11	9
2019	Circuit3065	17	32	17	22	29	0	1	10
2019	Circuit3066	5	21	25	17	11	21	3	12
2019	Circuit3068	0	0	0	0	0	0	0	0
2019	Circuit3069	0	2	1	1	0	0	0	0
2019	Circuit1779	10	10	6	9	9	0	0	3
2019	Circuit3070	2	7	7	5	4	14	3	7
2019	Circuit3071	3	10	6	6	16	29	4	16
2019	Circuit3072	1	6	5	4	9	14	8	10
2019	Circuit3073	4	10	6	7	8	13	11	11
2019	Circuit3074	0	14	14	9	14	17	8	13
2019	Circuit1780	2	1	0	1	1	7	4	4
2019	Circuit1781	1	0	0	0	0	0	0	0
2019	Circuit1782	2	3	0	2	1	3	1	2
2019	Circuit1783	1	0	1	1	1	0	0	0
2019	Circuit1785	2	3	1	2	0	1	1	1
2019	Circuit1786	0	0	0	0	0	0	0	0
2019	Circuit1788	0	0	0	0	1	0	0	0
2019	Circuit1789	8	9	11	9	18	24	14	19
2019	Circuit1790	13	33	24	23	16	14	12	14
2019	Circuit1791	2	2	9	4	11	8	10	10
2019	Circuit1792	31	47	22	33	30	38	13	27
2019	Circuit1793	5	2	4	4	13	9	11	11
2019	Circuit1794	5	12	17	11	11	25	14	17
2019	Circuit1795	2	0	1	1	3	3	2	3
2019	Circuit3657	1	0	0	0	0	0	0	0
2019	Circuit3658	0	0	0	0	0	0	0	0
2019	Circuit3606	1	1	2	1	1	0	0	0
2019	Circuit3607	0	1	0	0	1	0	0	0
2019	Circuit3608	1	0	0	0	0	0	0	0
2019	Circuit3609	0	1	0	0	2	3	0	2

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3659	0	0	0	0	0	0	0	0
2019	Circuit3661	0	0	0	0	0	0	0	0
2019	Circuit3713	0	0	0	0	0	0	0	0
2019	Circuit3662	0	0	0	0	0	0	0	0
2019	Circuit3663	0	1	0	0	0	0	0	0
2019	Circuit3611	6	3	7	5	2	0	1	1
2019	Circuit3714	0	0	0	0	0	0	0	0
2019	Circuit3094	0	1	0	0	0	0	0	0
2019	Circuit3096	0	0	1	0	2	3	1	2
2019	Circuit3097	10	8	19	12	17	47	36	33
2019	Circuit3099	9	17	11	12	23	28	24	25
2019	Circuit3747	0	0	0	0	0	0	0	0
2019	Circuit3100	5	19	27	17	19	44	27	30
2019	Circuit3101	5	18	12	12	14	30	34	26
2019	Circuit3102	3	7	7	6	18	8	9	12
2019	Circuit3758	1	0	0	0	0	0	0	0
2019	Circuit1798	3	27	20	17	18	20	30	23
2019	Circuit1799	8	30	50	29	18	37	23	26
2019	Circuit1800	6	15	25	15	21	24	38	28
2019	Circuit1801	8	16	23	16	12	14	31	19
2019	Circuit1802	10	13	12	12	15	20	14	16
2019	Circuit1803	2	2	3	2	1	1	1	1
2019	Circuit1804	9	8	13	10	14	30	20	21
2019	Circuit1805	1	0	0	0	1	0	0	0
2019	Circuit3124	1	0	0	0	0	0	1	0
2019	Circuit3126	2	4	2	3	1	1	1	1
2019	Circuit3131	13	17	19	16	21	21	38	27
2019	Circuit4090	0	0	2	1	0	0	0	0
2019	Circuit1812	3	4	1	3	0	5	4	3
2019	Circuit1815	1	1	1	1	1	1	3	2
2019	Circuit1816	1	0	0	0	0	0	0	0
2019	Circuit1817	0	0	0	0	0	0	0	0
2019	Circuit3667	0	0	0	0	0	0	0	0
2019	Circuit1818	0	2	0	1	0	2	0	1
2019	Circuit1819	1	1	2	1	1	2	3	2
2019	Circuit1820	8	21	12	14	6	20	10	12
2019	Circuit1821	2	16	21	13	7	5	15	9
2019	Circuit1822	3	12	3	6	4	4	6	5
2019	Circuit1823	11	9	12	11	5	16	6	9
2019	Circuit1824	23	23	35	27	38	48	24	37
2019	Circuit1825	6	18	14	13	20	10	22	17
2019	Circuit1826	4	4	7	5	2	11	8	7
2019	Circuit3156	0	0	0	0	0	1	0	0
2019	Circuit1269	0	0	0	0	0	0	0	0
2019	Circuit1827	1	4	6	4	6	2	2	3

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1828	9	3	11	8	11	17	3	10
2019	Circuit1829	4	2	9	5	10	8	4	7
2019	Circuit1830	4	8	12	8	5	14	14	11
2019	Circuit3184	3	2	0	2	1	3	0	1
2019	Circuit3185	2	1	5	3	1	7	6	5
2019	Circuit3186	6	17	6	10	19	22	17	19
2019	Circuit3187	5	11	8	8	13	22	7	14
2019	Circuit3188	2	2	3	2	7	15	6	9
2019	Circuit3189	0	0	0	0	0	0	0	0
2019	Circuit3190	7	4	2	4	1	14	3	6
2019	Circuit3192	4	12	5	7	6	21	8	12
2019	Circuit3193	2	4	2	3	7	12	6	8
2019	Circuit3194	7	8	2	6	9	11	19	13
2019	Circuit3195	7	5	9	7	6	21	7	11
2019	Circuit1839	3	6	5	5	17	7	7	10
2019	Circuit1845	3	2	21	9	2	12	7	7
2019	Circuit1846	1	4	5	3	3	4	4	4
2019	Circuit1847	0	0	0	0	0	0	0	0
2019	Circuit1848	3	10	5	6	5	11	1	6
2019	Circuit1849	4	5	7	5	2	2	8	4
2019	Circuit1850	0	0	0	0	0	1	0	0
2019	Circuit1851	2	6	7	5	5	4	4	4
2019	Circuit1852	0	0	1	0	1	0	0	0
2019	Circuit1853	0	1	0	0	4	12	1	6
2019	Circuit1854	2	4	5	4	1	2	1	1
2019	Circuit3752	1	2	0	1	1	0	0	0
2019	Circuit1433	4	4	4	4	3	4	5	4
2019	Circuit1434	2	10	7	6	6	7	7	7
2019	Circuit2145	1	13	3	6	1	19	4	8
2019	Circuit2146	3	16	11	10	14	31	9	18
2019	Circuit2147	6	15	4	8	4	32	6	14
2019	Circuit1298	3	2	4	3	1	5	9	5
2019	Circuit3735	0	0	0	0	0	0	0	0
2019	Circuit979	0	0	0	0	0	1	0	0
2019	Circuit980	0	1	0	0	0	0	1	0
2019	Circuit3677	0	0	0	0	0	0	0	0
2019	Circuit981	0	0	0	0	0	0	0	0
2019	Circuit3303	0	0	0	0	0	0	0	0
2019	Circuit1877	0	0	0	0	0	0	0	0
2019	Circuit1878	5	17	25	16	13	10	11	11
2019	Circuit1879	1	2	0	1	0	2	2	1
2019	Circuit1880	6	16	12	11	18	34	11	21
2019	Circuit2150	15	20	30	22	12	31	20	21
2019	Circuit3314	1	0	1	1	0	0	0	0
2019	Circuit3315	0	0	0	0	0	0	0	0

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3316	5	0	3	3	5	5	1	4
2019	Circuit3317	3	6	5	5	9	10	15	11
2019	Circuit3318	4	5	3	4	4	3	3	3
2019	Circuit3319	4	4	7	5	7	7	3	6
2019	Circuit3320	8	5	9	7	11	15	30	19
2019	Circuit3321	6	13	11	10	7	9	6	7
2019	Circuit3322	3	0	3	2	7	8	12	9
2019	Circuit3323	0	1	1	1	14	9	7	10
2019	Circuit3324	2	3	11	5	4	8	8	7
2019	Circuit3757	0	0	0	0	0	0	0	0
2019	Circuit2167	8	9	4	7	3	13	9	8
2019	Circuit2165	3	11	11	8	3	5	6	5
2019	Circuit2166	1	10	5	5	3	20	7	10
2019	Circuit1314	0	0	0	0	0	0	0	0
2019	Circuit3395	13	16	29	19	19	53	32	35
2019	Circuit3397	0	1	1	1	0	5	1	2
2019	Circuit3398	6	3	0	3	5	6	16	9
2019	Circuit3399	0	0	0	0	0	0	0	0
2019	Circuit3400	5	4	5	5	11	15	15	14
2019	Circuit1461	0	0	0	0	0	0	0	0
2019	Circuit3724	0	0	0	0	0	0	0	0
2019	Circuit1907	0	0	0	0	0	0	0	0
2019	Circuit1908	0	0	3	1	2	0	2	1
2019	Circuit1910	4	3	5	4	4	10	9	8
2019	Circuit1912	11	14	14	13	4	19	27	17
2019	Circuit1926	0	0	0	0	0	1	0	0
2019	Circuit1009	1	7	6	5	27	13	5	15
2019	Circuit1010	6	7	3	5	8	18	7	11
2019	Circuit1011	0	4	6	3	29	9	7	15
2019	Circuit1012	8	23	3	11	6	5	8	6
2019	Circuit1013	0	8	6	5	7	12	3	7
2019	Circuit1014	3	10	5	6	22	12	8	14
2019	Circuit1016	3	4	8	5	10	17	10	12
2019	Circuit1017	1	3	10	5	16	15	12	14
2019	Circuit1018	0	3	1	1	7	8	4	6
2019	Circuit1019	13	26	13	17	46	9	13	23
2019	Circuit1022	6	32	15	18	23	25	12	20
2019	Circuit1023	4	7	1	4	7	4	4	5
2019	Circuit3732	0	0	0	0	0	0	0	0
2019	Circuit1936	0	1	0	0	0	1	1	1
2019	Circuit1938	0	1	0	0	0	1	0	0
2019	Circuit1939	6	23	15	15	16	14	6	12
2019	Circuit1940	14	39	20	24	10	14	12	12
2019	Circuit1941	14	24	23	20	23	34	8	22
2019	Circuit1024	0	2	4	2	4	1	1	2

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1026	0	0	4	1	0	0	0	0
2019	Circuit1028	0	1	2	1	1	1	1	1
2019	Circuit1029	2	0	0	1	1	0	1	1
2019	Circuit1030	0	0	1	0	1	2	8	4
2019	Circuit1031	0	1	0	0	0	0	0	0
2019	Circuit1032	0	0	0	0	0	0	1	0
2019	Circuit1033	0	1	0	0	1	0	2	1
2019	Circuit1034	0	1	2	1	1	1	0	1
2019	Circuit1037	0	0	0	0	2	0	0	1
2019	Circuit3746	0	0	0	0	0	0	0	0
2019	Circuit3729	0	0	0	0	0	0	0	0
2019	Circuit3484	1	0	1	1	2	3	1	2
2019	Circuit3722	1	0	0	0	0	0	0	0
2019	Circuit3486	1	0	3	1	0	1	1	1
2019	Circuit3487	0	1	1	1	1	3	1	2
2019	Circuit3488	0	0	0	0	0	0	1	0
2019	Circuit3489	0	3	9	4	14	34	10	19
2019	Circuit3490	0	3	17	7	17	21	12	17
2019	Circuit3690	3	1	1	2	0	0	0	0
2019	Circuit3491	8	9	20	12	21	19	4	15
2019	Circuit3492	1	8	8	6	5	11	13	10
2019	Circuit3493	5	9	19	11	12	16	12	13
2019	Circuit3494	0	0	0	0	0	0	0	0
2019	Circuit3495	3	8	3	5	13	19	3	12
2019	Circuit3496	7	6	10	8	1	9	3	4
2019	Circuit3497	0	8	13	7	2	11	11	8
2019	Circuit3498	9	13	16	13	23	17	9	16
2019	Circuit3499	3	20	14	12	8	21	12	14
2019	Circuit3501	4	19	20	14	12	18	9	13
2019	Circuit3502	12	13	19	15	21	14	5	13
2019	Circuit3503	6	8	11	8	28	12	18	19
2019	Circuit3509	2	14	5	7	6	7	4	6
2019	Circuit3510	16	7	18	14	16	30	11	19
2019	Circuit3511	2	5	3	3	3	16	3	7
2019	Circuit3513	0	1	0	0	1	1	0	1
2019	Circuit3723	0	1	1	1	0	0	0	0
2019	Circuit3535	0	0	0	0	0	0	0	0
2019	Circuit3686	1	1	0	1	0	0	0	0
2019	Circuit3536	0	0	0	0	2	0	1	1
2019	Circuit3687	1	2	0	1	0	0	0	0
2019	Circuit3537	1	1	4	2	3	1	5	3
2019	Circuit3688	0	0	0	0	0	0	0	0
2019	Circuit3619	5	21	28	18	0	0	0	0
2019	Circuit3621	23	43	20	29	0	0	0	0
2019	Circuit1047	7	42	25	25	14	6	11	10

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1048	15	28	18	20	15	15	14	15
2019	Circuit2376	0	0	0	0	12	16	7	12
2019	Circuit1049	19	32	12	21	20	9	10	13
2019	Circuit2377	0	0	2	1	22	29	15	22
2019	Circuit2378	0	0	0	0	19	21	22	21
2019	Circuit2679	0	0	0	0	0	1	2	1
2019	Circuit2681	0	0	0	0	0	18	30	16
2020	Circuit206	14	11	9	11	3	7	3	4
2020	Circuit208	5	3	3	4	6	2	2	3
2020	Circuit211	23	13	6	14	9	18	11	13
2020	Circuit2434	3	7	9	6	4	12	7	8
2020	Circuit2438	5	1	6	4	1	1	0	1
2020	Circuit2439	13	5	4	7	6	9	4	6
2020	Circuit3624	0	0	0	0	0	0	0	0
2020	Circuit2441	0	0	2	1	0	3	2	2
2020	Circuit2442	5	15	13	11	15	18	5	13
2020	Circuit2443	14	14	6	11	9	13	6	9
2020	Circuit2444	6	5	3	5	7	14	1	7
2020	Circuit2445	9	4	7	7	7	21	6	11
2020	Circuit2446	7	4	10	7	6	12	1	6
2020	Circuit2447	13	10	9	11	13	32	5	17
2020	Circuit4092	0	0	0	0	0	0	0	0
2020	Circuit3625	0	0	0	0	0	0	0	0
2020	Circuit2455	4	1	0	2	0	1	0	0
2020	Circuit2460	1	0	2	1	2	1	1	1
2020	Circuit2466	1	0	0	0	0	0	0	0
2020	Circuit2472	6	2	1	3	4	3	1	3
2020	Circuit2473	5	7	2	5	2	5	2	3
2020	Circuit2474	1	3	1	2	2	1	0	1
2020	Circuit1595	0	0	0	0	0	0	0	0
2020	Circuit3741	0	0	0	0	0	0	0	0
2020	Circuit2527	0	0	0	0	0	0	0	0
2020	Circuit2019	1	0	0	0	1	0	2	1
2020	Circuit2020	4	0	0	1	1	3	1	2
2020	Circuit2023	30	11	7	16	8	9	5	7
2020	Circuit2025	11	8	4	8	13	11	2	9
2020	Circuit3728	0	0	0	0	0	0	0	0
2020	Circuit1629	8	3	6	6	17	20	1	13
2020	Circuit1630	21	8	19	16	8	9	6	8
2020	Circuit1631	3	11	17	10	34	11	3	16
2020	Circuit1632	7	10	5	7	9	10	3	7
2020	Circuit1633	17	10	2	10	22	14	2	13
2020	Circuit2559	10	19	7	12	13	14	4	10
2020	Circuit1634	6	12	4	7	19	6	1	9
2020	Circuit2566	4	5	1	3	11	4	2	6

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2578	17	17	26	20	28	4	6	13
2020	Circuit2579	9	18	5	11	9	3	7	6
2020	Circuit3730	0	0	0	0	0	0	0	0
2020	Circuit1238	0	0	0	0	0	0	0	0
2020	Circuit1241	0	0	0	0	0	0	0	0
2020	Circuit1244	0	7	13	7	8	11	1	7
2020	Circuit1245	7	6	10	8	5	7	1	4
2020	Circuit1246	3	8	5	5	3	12	0	5
2020	Circuit3710	0	0	1	0	0	0	0	0
2020	Circuit828	24	23	45	31	25	9	7	14
2020	Circuit829	53	29	44	42	16	16	9	14
2020	Circuit830	18	15	27	20	17	6	4	9
2020	Circuit832	23	13	26	21	23	12	4	13
2020	Circuit835	28	21	24	24	35	25	6	22
2020	Circuit4093	0	0	0	0	0	0	0	0
2020	Circuit3578	9	0	0	3	0	0	0	0
2020	Circuit1663	5	11	6	7	3	4	3	3
2020	Circuit1664	9	12	7	9	6	10	2	6
2020	Circuit1665	14	8	3	8	9	5	9	8
2020	Circuit1666	26	19	14	20	9	27	7	14
2020	Circuit1668	14	15	5	11	4	1	2	2
2020	Circuit1669	8	15	7	10	8	10	11	10
2020	Circuit3742	0	0	0	0	0	0	0	0
2020	Circuit3739	0	0	0	0	0	0	0	0
2020	Circuit1684	4	3	0	2	13	6	1	7
2020	Circuit1685	17	9	5	10	24	5	3	11
2020	Circuit1686	10	7	13	10	34	15	5	18
2020	Circuit1687	9	2	4	5	10	3	2	5
2020	Circuit1688	7	7	18	11	11	12	9	11
2020	Circuit2729	0	0	1	0	0	0	0	0
2020	Circuit2730	0	0	0	0	0	1	0	0
2020	Circuit2731	1	0	0	0	0	0	0	0
2020	Circuit2732	0	0	1	0	0	0	0	0
2020	Circuit2733	0	0	0	0	3	1	0	1
2020	Circuit2734	8	2	4	5	8	2	10	7
2020	Circuit2737	14	20	10	15	17	27	8	17
2020	Circuit2738	16	8	7	10	12	8	5	8
2020	Circuit2739	18	8	16	14	19	20	8	16
2020	Circuit2740	34	14	5	18	13	9	6	9
2020	Circuit2741	7	5	7	6	6	5	6	6
2020	Circuit2742	24	31	13	23	23	20	8	17
2020	Circuit2744	17	9	22	16	28	15	2	15
2020	Circuit2745	7	11	6	8	15	6	3	8
2020	Circuit2746	1	17	7	8	14	14	2	10
2020	Circuit2752	16	14	12	14	18	19	4	14

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2753	5	9	11	8	10	2	3	5
2020	Circuit2754	12	8	16	12	7	4	3	5
2020	Circuit2755	11	1	3	5	14	1	6	7
2020	Circuit2756	6	11	2	6	8	0	2	3
2020	Circuit4087	0	0	0	0	0	0	0	0
2020	Circuit875	9	21	9	13	23	9	3	12
2020	Circuit876	29	19	14	21	23	16	6	15
2020	Circuit3712	0	0	0	0	0	0	0	0
2020	Circuit3641	0	0	0	0	0	0	0	0
2020	Circuit3587	10	7	4	7	0	0	0	0
2020	Circuit1701	12	11	6	10	0	0	0	0
2020	Circuit3588	11	8	10	10	0	0	0	0
2020	Circuit2058	0	0	0	0	0	0	0	0
2020	Circuit2060	10	11	4	8	4	10	1	5
2020	Circuit4088	0	0	0	0	0	0	0	0
2020	Circuit2790	5	15	7	9	22	13	3	13
2020	Circuit2791	17	6	4	9	15	9	4	9
2020	Circuit2792	16	22	21	20	24	18	11	18
2020	Circuit2794	13	15	7	12	27	8	6	14
2020	Circuit2795	0	1	0	0	0	0	0	0
2020	Circuit2807	5	3	2	3	4	3	4	4
2020	Circuit2808	6	5	7	6	13	16	1	10
2020	Circuit881	0	0	0	0	0	0	0	0
2020	Circuit887	6	6	10	7	18	21	2	14
2020	Circuit888	4	1	3	3	2	6	0	3
2020	Circuit2063	7	4	4	5	8	4	4	5
2020	Circuit3745	0	0	0	0	0	0	0	0
2020	Circuit2066	0	0	0	0	0	0	1	0
2020	Circuit2067	3	1	3	2	6	2	0	3
2020	Circuit2068	33	14	25	24	71	13	5	30
2020	Circuit2070	12	13	9	11	35	11	3	16
2020	Circuit2071	5	5	5	5	16	3	1	7
2020	Circuit2072	8	4	3	5	6	1	3	3
2020	Circuit3740	0	0	0	0	0	0	0	0
2020	Circuit3622	0	0	0	0	0	0	0	0
2020	Circuit3643	0	0	0	0	0	0	0	0
2020	Circuit3623	0	0	0	0	0	0	0	0
2020	Circuit897	1	1	1	1	0	0	0	0
2020	Circuit898	1	0	0	0	0	0	1	0
2020	Circuit901	5	5	0	3	2	0	0	1
2020	Circuit903	6	5	7	6	14	9	2	8
2020	Circuit1708	28	25	32	28	17	8	10	12
2020	Circuit1709	19	5	2	9	13	2	2	6
2020	Circuit2083	12	10	15	12	1	14	8	8
2020	Circuit2084	14	4	7	8	11	1	8	7

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2085	15	18	10	14	7	2	8	6
2020	Circuit2086	0	0	0	0	0	0	2	1
2020	Circuit2087	3	4	7	5	25	12	5	14
2020	Circuit2088	28	17	15	20	2	5	2	3
2020	Circuit3744	0	0	0	0	0	0	0	0
2020	Circuit1719	0	0	0	0	0	0	0	0
2020	Circuit1726	0	0	0	0	0	0	3	1
2020	Circuit1727	1	0	0	0	2	2	0	1
2020	Circuit1728	1	0	0	0	0	1	1	1
2020	Circuit1729	0	0	0	0	0	0	1	0
2020	Circuit1730	1	0	0	0	0	0	1	0
2020	Circuit1732	24	9	18	17	12	18	5	12
2020	Circuit1733	13	24	13	17	17	9	5	10
2020	Circuit1734	7	23	17	16	15	10	5	10
2020	Circuit1735	4	27	5	12	22	21	5	16
2020	Circuit1736	8	25	26	20	26	21	2	16
2020	Circuit1737	16	12	12	13	14	9	7	10
2020	Circuit1738	42	40	23	35	24	24	0	16
2020	Circuit1739	14	21	20	18	12	24	18	18
2020	Circuit4094	0	0	0	0	0	0	0	0
2020	Circuit2859	7	14	3	8	10	13	2	8
2020	Circuit1401	4	3	7	5	10	2	1	4
2020	Circuit1402	8	6	12	9	12	0	5	6
2020	Circuit3644	0	0	0	0	0	0	0	0
2020	Circuit2862	0	0	0	0	2	1	0	1
2020	Circuit2863	1	0	1	1	2	0	0	1
2020	Circuit2864	2	2	2	2	7	2	0	3
2020	Circuit2865	20	14	14	16	18	12	9	13
2020	Circuit2866	11	26	30	22	25	19	19	21
2020	Circuit2867	0	0	0	0	0	0	0	0
2020	Circuit2869	8	20	14	14	17	9	9	12
2020	Circuit2870	39	18	29	29	30	20	9	20
2020	Circuit2877	8	5	0	4	10	5	0	5
2020	Circuit2878	0	0	0	0	0	0	0	0
2020	Circuit2879	2	2	1	2	9	2	1	4
2020	Circuit2881	1	1	1	1	3	2	0	2
2020	Circuit2882	3	4	3	3	2	6	0	3
2020	Circuit2884	3	7	5	5	2	3	1	2
2020	Circuit2885	5	7	1	4	10	7	4	7
2020	Circuit2886	11	6	8	8	4	4	2	3
2020	Circuit2887	9	3	9	7	4	15	6	8
2020	Circuit2888	1	1	3	2	6	2	2	3
2020	Circuit2889	5	6	11	7	14	2	4	7
2020	Circuit2890	10	6	13	10	9	14	2	8
2020	Circuit2895	7	8	7	7	9	3	1	4

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit1744	0	0	1	0	0	0	1	0
2020	Circuit3727	0	0	0	0	0	0	0	0
2020	Circuit3590	1	0	1	1	0	0	0	0
2020	Circuit3591	1	1	0	1	0	0	0	0
2020	Circuit3592	4	6	7	6	0	0	0	0
2020	Circuit3594	4	8	1	4	0	0	0	0
2020	Circuit3595	21	15	5	14	0	0	0	0
2020	Circuit1752	12	10	6	9	13	1	2	5
2020	Circuit1753	7	5	2	5	7	9	5	7
2020	Circuit1759	15	11	2	9	11	18	5	11
2020	Circuit1754	3	3	5	4	31	8	3	14
2020	Circuit1755	2	10	1	4	10	0	4	5
2020	Circuit1756	7	8	6	7	13	22	9	15
2020	Circuit3646	0	0	0	0	0	0	0	0
2020	Circuit2931	0	0	0	0	0	0	0	0
2020	Circuit2932	6	20	7	11	21	14	9	15
2020	Circuit2933	11	21	15	16	26	27	6	20
2020	Circuit2934	32	25	11	23	22	36	12	23
2020	Circuit2935	23	25	16	21	25	34	16	25
2020	Circuit2936	3	4	5	4	6	4	1	4
2020	Circuit2937	7	10	3	7	3	7	2	4
2020	Circuit1764	0	0	0	0	0	0	0	0
2020	Circuit1250	0	2	1	1	2	1	0	1
2020	Circuit1252	5	1	5	4	10	6	0	5
2020	Circuit1253	15	28	17	20	15	9	6	10
2020	Circuit1255	10	9	8	9	10	10	6	9
2020	Circuit1256	24	23	14	20	13	16	7	12
2020	Circuit1257	0	2	1	1	1	0	1	1
2020	Circuit944	7	6	8	7	8	5	2	5
2020	Circuit945	0	0	1	0	0	1	1	1
2020	Circuit946	3	9	9	7	4	2	1	2
2020	Circuit947	1	1	2	1	0	7	3	3
2020	Circuit3651	0	0	0	0	0	0	0	0
2020	Circuit1766	9	5	0	5	2	4	4	3
2020	Circuit1768	1	2	2	2	13	4	5	7
2020	Circuit1769	7	2	2	4	6	7	2	5
2020	Circuit1771	1	0	0	0	0	0	1	0
2020	Circuit1772	1	13	6	7	1	8	0	3
2020	Circuit1773	36	4	7	16	17	10	0	9
2020	Circuit1774	23	10	9	14	10	1	0	4
2020	Circuit948	0	0	2	1	0	0	0	0
2020	Circuit951	27	15	17	20	26	14	5	15
2020	Circuit952	29	11	16	19	9	8	4	7
2020	Circuit953	16	13	11	13	17	7	4	9
2020	Circuit954	25	29	38	31	21	11	7	13

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit955	24	28	25	26	26	18	4	16
2020	Circuit4089	0	0	0	0	0	0	0	0
2020	Circuit2993	1	0	0	0	1	1	0	1
2020	Circuit2994	1	0	1	1	1	1	1	1
2020	Circuit2995	15	9	11	12	28	34	14	25
2020	Circuit2996	5	7	15	9	24	14	6	15
2020	Circuit2997	13	5	10	9	14	10	6	10
2020	Circuit2998	12	20	11	14	9	7	8	8
2020	Circuit2999	9	23	15	16	5	6	3	5
2020	Circuit3737	0	0	0	0	0	0	0	0
2020	Circuit959	0	0	0	0	1	0	8	3
2020	Circuit3598	0	1	0	0	0	0	0	0
2020	Circuit3041	3	1	2	2	5	3	0	3
2020	Circuit3056	1	0	1	1	0	0	0	0
2020	Circuit3064	3	7	2	4	11	11	4	9
2020	Circuit3065	32	17	11	20	13	1	4	6
2020	Circuit3066	21	25	15	20	21	3	5	10
2020	Circuit3068	0	0	0	0	0	0	0	0
2020	Circuit3069	2	1	1	1	0	0	0	0
2020	Circuit1779	10	6	9	8	5	0	6	4
2020	Circuit3070	7	7	4	6	14	3	2	6
2020	Circuit3071	10	6	7	8	29	4	5	13
2020	Circuit3072	6	5	5	5	14	8	2	8
2020	Circuit3073	10	6	6	7	13	11	1	8
2020	Circuit3074	14	14	11	13	17	8	5	10
2020	Circuit1780	1	0	4	2	7	4	0	4
2020	Circuit1781	0	0	0	0	0	0	0	0
2020	Circuit1782	3	0	2	2	3	1	0	1
2020	Circuit1783	0	1	3	1	0	0	0	0
2020	Circuit1785	3	1	1	2	1	1	0	1
2020	Circuit1786	0	0	0	0	0	0	0	0
2020	Circuit1788	0	0	0	0	0	0	1	0
2020	Circuit1789	9	11	30	17	24	14	1	13
2020	Circuit1790	33	24	13	23	14	12	0	9
2020	Circuit1791	2	9	10	7	8	10	1	6
2020	Circuit1792	47	22	30	33	38	13	0	17
2020	Circuit1793	2	4	3	3	9	11	0	7
2020	Circuit1794	12	17	19	16	25	14	0	13
2020	Circuit1795	0	1	1	1	3	2	6	4
2020	Circuit3657	0	0	0	0	0	0	0	0
2020	Circuit3658	0	0	0	0	0	0	0	0
2020	Circuit3606	1	2	2	2	0	0	0	0
2020	Circuit3607	1	0	0	0	0	0	0	0
2020	Circuit3608	0	0	0	0	0	0	0	0
2020	Circuit3609	1	0	0	0	3	0	0	1

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3659	0	0	0	0	0	0	0	0
2020	Circuit3661	0	0	0	0	0	0	0	0
2020	Circuit3713	0	0	0	0	0	0	0	0
2020	Circuit3662	0	0	1	0	0	0	0	0
2020	Circuit3663	1	0	0	0	0	0	0	0
2020	Circuit3611	3	7	5	5	0	1	0	0
2020	Circuit3714	0	0	0	0	0	0	0	0
2020	Circuit3094	1	0	0	0	0	0	0	0
2020	Circuit3096	0	1	2	1	3	1	0	1
2020	Circuit3097	8	19	21	16	47	36	6	30
2020	Circuit3099	17	11	11	13	28	24	10	21
2020	Circuit3747	0	0	0	0	0	0	0	0
2020	Circuit3100	19	27	20	22	45	27	4	25
2020	Circuit3101	18	12	22	17	30	34	4	23
2020	Circuit3102	7	7	12	9	8	9	6	8
2020	Circuit3758	0	0	0	0	0	0	0	0
2020	Circuit1798	27	20	22	23	20	30	12	21
2020	Circuit1799	30	50	25	35	37	23	2	21
2020	Circuit1800	15	25	18	19	24	38	6	23
2020	Circuit1801	16	23	15	18	14	31	9	18
2020	Circuit1802	13	12	14	13	20	14	9	14
2020	Circuit1803	2	3	1	2	1	1	1	1
2020	Circuit1804	8	13	18	13	30	20	10	20
2020	Circuit1805	0	0	1	0	0	0	1	0
2020	Circuit3124	0	0	0	0	0	1	0	0
2020	Circuit3126	4	2	0	2	1	1	0	1
2020	Circuit3131	17	19	25	20	21	38	15	25
2020	Circuit4090	0	2	0	1	0	0	0	0
2020	Circuit1812	4	1	2	2	5	4	2	4
2020	Circuit1815	1	1	0	1	1	3	0	1
2020	Circuit1816	0	0	0	0	0	0	0	0
2020	Circuit1817	0	0	0	0	0	0	0	0
2020	Circuit3667	0	0	0	0	0	0	0	0
2020	Circuit1818	2	0	0	1	2	0	0	1
2020	Circuit1819	1	2	3	2	2	3	1	2
2020	Circuit1820	21	12	4	12	20	10	1	10
2020	Circuit1821	16	21	15	17	5	15	3	8
2020	Circuit1822	12	3	6	7	4	6	0	3
2020	Circuit1823	9	12	7	9	16	6	3	8
2020	Circuit1824	23	35	36	31	48	24	15	29
2020	Circuit1825	18	14	17	16	10	22	0	11
2020	Circuit1826	4	7	8	6	11	8	10	10
2020	Circuit3156	0	0	0	0	1	0	1	1
2020	Circuit1269	0	0	0	0	0	0	0	0
2020	Circuit1827	4	6	2	4	2	2	1	2

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit1828	3	11	7	7	17	3	4	8
2020	Circuit1829	2	9	6	6	8	4	1	4
2020	Circuit1830	8	12	11	10	14	14	5	11
2020	Circuit3184	2	0	0	1	3	0	0	1
2020	Circuit3185	1	5	5	4	7	6	0	4
2020	Circuit3186	17	6	23	15	22	17	8	16
2020	Circuit3187	11	8	6	8	22	7	6	12
2020	Circuit3188	2	3	11	5	15	6	2	8
2020	Circuit3189	0	0	0	0	0	0	0	0
2020	Circuit3190	4	2	4	3	14	3	0	6
2020	Circuit3192	12	5	11	9	21	8	13	14
2020	Circuit3193	4	2	2	3	12	6	4	7
2020	Circuit3194	8	2	10	7	11	19	6	12
2020	Circuit3195	5	9	10	8	21	7	3	10
2020	Circuit1839	6	5	3	5	7	7	3	6
2020	Circuit1845	2	21	14	12	12	7	5	8
2020	Circuit1846	4	5	2	4	4	4	1	3
2020	Circuit1847	0	0	0	0	0	0	0	0
2020	Circuit1848	10	5	7	7	11	1	1	4
2020	Circuit1849	5	7	11	8	2	8	3	4
2020	Circuit1850	0	0	2	1	1	0	0	0
2020	Circuit1851	6	7	8	7	4	4	0	3
2020	Circuit1852	0	1	1	1	0	0	0	0
2020	Circuit1853	1	0	2	1	12	1	2	5
2020	Circuit1854	4	5	17	9	2	1	1	1
2020	Circuit3752	2	0	0	1	0	0	0	0
2020	Circuit1434	10	7	8	8	7	7	5	6
2020	Circuit3735	0	0	0	0	0	0	0	0
2020	Circuit979	0	0	0	0	1	0	0	0
2020	Circuit980	1	0	3	1	0	1	0	0
2020	Circuit3677	0	0	0	0	0	0	0	0
2020	Circuit981	0	0	0	0	0	0	0	0
2020	Circuit3303	0	0	0	0	0	0	0	0
2020	Circuit1877	0	0	0	0	0	0	0	0
2020	Circuit2150	20	30	17	22	31	20	10	20
2020	Circuit3314	0	1	0	0	0	0	0	0
2020	Circuit3315	0	0	0	0	0	0	1	0
2020	Circuit3316	0	3	2	2	5	1	2	3
2020	Circuit3317	6	5	6	6	10	15	3	9
2020	Circuit3318	5	3	2	3	3	3	4	3
2020	Circuit3319	4	7	12	8	7	3	3	4
2020	Circuit3320	5	9	6	7	15	30	7	17
2020	Circuit3321	13	11	7	10	9	6	3	6
2020	Circuit3322	0	3	1	1	8	12	4	8
2020	Circuit3323	1	1	3	2	9	7	4	7

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3324	3	11	12	9	8	8	6	7
2020	Circuit3757	0	0	0	0	0	0	0	0
2020	Circuit1314	0	0	0	0	0	0	0	0
2020	Circuit3395	16	29	16	20	53	32	14	33
2020	Circuit3397	1	1	6	3	5	1	1	2
2020	Circuit3398	3	0	3	2	6	16	3	8
2020	Circuit3399	0	0	0	0	0	0	0	0
2020	Circuit3400	4	5	10	6	15	15	5	12
2020	Circuit1461	0	0	0	0	0	0	0	0
2020	Circuit3724	0	0	0	0	0	0	0	0
2020	Circuit1926	0	0	2	1	1	0	0	0
2020	Circuit1009	7	6	7	7	13	5	8	9
2020	Circuit1010	7	3	10	7	18	7	3	9
2020	Circuit1012	23	3	13	13	5	8	0	4
2020	Circuit1013	8	6	12	9	12	3	5	7
2020	Circuit1014	10	5	11	9	12	8	3	8
2020	Circuit1016	4	8	17	10	17	10	1	9
2020	Circuit1017	3	10	8	7	15	12	3	10
2020	Circuit1018	3	1	7	4	8	4	1	4
2020	Circuit1019	26	13	14	18	9	13	5	9
2020	Circuit1022	32	15	15	21	25	12	8	15
2020	Circuit1023	7	1	5	4	4	4	0	3
2020	Circuit3732	0	0	0	0	0	0	0	0
2020	Circuit1030	0	1	0	0	2	8	0	3
2020	Circuit1037	0	0	0	0	0	0	1	0
2020	Circuit3746	0	0	0	0	0	0	0	0
2020	Circuit3729	0	0	0	0	0	0	0	0
2020	Circuit3484	0	1	1	1	3	1	1	2
2020	Circuit3722	0	0	0	0	0	0	0	0
2020	Circuit3486	0	3	1	1	1	1	0	1
2020	Circuit3487	1	1	2	1	3	1	0	1
2020	Circuit3488	0	0	0	0	0	1	0	0
2020	Circuit3489	3	9	8	7	34	10	14	19
2020	Circuit3490	3	17	9	10	21	12	0	11
2020	Circuit3690	1	1	0	1	0	0	0	0
2020	Circuit3491	9	20	16	15	19	4	9	11
2020	Circuit3492	8	8	4	7	11	13	4	9
2020	Circuit3493	9	19	22	17	16	12	4	11
2020	Circuit3494	0	0	0	0	0	0	0	0
2020	Circuit3495	8	3	5	5	19	3	4	9
2020	Circuit3496	6	10	10	9	9	3	2	5
2020	Circuit3497	8	13	2	8	11	11	7	10
2020	Circuit3498	13	16	10	13	17	9	4	10
2020	Circuit3499	20	14	8	14	21	12	6	13
2020	Circuit3501	19	20	4	14	18	9	1	9

Year	Circuit	Wire Down Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3502	13	19	14	15	14	5	10	10
2020	Circuit3503	8	11	7	9	12	18	10	13
2020	Circuit3509	14	5	23	14	7	4	3	5
2020	Circuit3510	7	18	11	12	30	11	3	15
2020	Circuit3511	5	3	1	3	16	3	5	8
2020	Circuit3513	1	0	0	0	1	0	0	0
2020	Circuit3723	1	1	1	1	0	0	0	0
2020	Circuit3535	0	0	0	0	0	0	2	1
2020	Circuit3686	1	0	0	0	0	0	0	0
2020	Circuit3536	0	0	2	1	0	1	0	0
2020	Circuit3687	2	0	0	1	0	0	0	0
2020	Circuit3537	1	4	2	2	1	5	2	3
2020	Circuit3688	0	0	0	0	0	0	0	0
2020	Circuit3619	21	28	9	19	0	0	0	0
2020	Circuit3621	43	20	18	27	0	0	0	0
2020	Circuit2376	0	0	0	0	16	7	7	10
2020	Circuit2377	0	2	4	2	29	15	15	20
2020	Circuit2378	0	0	1	0	21	22	16	20
2020	Circuit2679	0	0	0	0	1	2	7	3
2020	Circuit2681	0	0	0	0	18	30	7	18

Michigan Public Service Commission

DTE Electric Company

Discovery Response: U-21534 MNSCDE-3.6-01

4.8kV Hardening Data

U-21534 MNSCDE-3.6-01 4.8kV Hardening Data

Total 2018-2020

108,980,667**108,980,783****124,853,186****114,271,545****110,353,703****89,523,696****84,253,072****94,710,157****EX MEDs CMI Control Group**

Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3715	3,937	303	103	1,448	-	-	-	-
2018	Circuit3720	126		52	89	-	-	-	-
2018	Circuit206	1,314	2,011	184,029	62,451	-	239,756	2,500	80,752
2018	Circuit208	8,977	5,780	47,375	20,711	-	402,181	12,249	138,143
2018	Circuit209	171,164	518,568	457,224	382,319	-	723,087	4,370	242,486
2018	Circuit211	38,368	27,993	91,615	52,659	-	778,975	14,131	264,369
2018	Circuit2434	3,167	2,166	7,123	4,152	4,101	17,479	3,451	8,344
2018	Circuit2436	28,618	36,056	23,665	29,446	13,543	41,523	7,311	20,792
2018	Circuit2438	1,154	54	158,721	53,310	238	2,057	1,836	1,377
2018	Circuit2439	105,974	2,836	249,319	119,376	1,798	14,751	17,598	11,382
2018	Circuit3624			343	343	-	0	0	-
2018	Circuit2440	49,941	14,092	17,844	27,292	642	4,898	370	1,970
2018	Circuit2441	1,728	157		943	59	20	61	47
2018	Circuit2442	102,215	398,807	54,210	185,077	12,867	151,462	338,202	167,510
2018	Circuit2443	24,099	8,344	485,984	172,809	23,773	18,799	24,413	22,328
2018	Circuit2444	2,577	162,220	4,831	56,543	20,962	7,350	39,028	22,447
2018	Circuit2445	3,376	4,542	476	2,798	32,700	1,495	51,739	28,645
2018	Circuit2446	4,376	29,187	6,192	13,252	30,015	9,203	200,923	80,047
2018	Circuit2447	48,820	12,062	2,352	21,078	15,251	134,015	28,202	59,156
2018	Circuit2455	113	1,043	1,887	1,014	-	18,591	608	6,400
2018	Circuit2460	523	351	632	502	10,191	1,089	7,950	6,410
2018	Circuit2466			213	213	-	68	0	23
2018	Circuit2472	5,294	294	24,612	10,067	7,120	1,596	8,366	5,694
2018	Circuit2473	6,414	13,168	72,079	30,554	404,378	194,921	57,482	218,927
2018	Circuit2474	158,849	5,898	2,423	55,723	7,808	131,719	391	46,639
2018	Circuit1595			1,432	1,432	-	0	0	-
2018	Circuit1596			8,322	8,322	2,238	3,488	342	2,023
2018	Circuit1597	870	2,455	45,605	16,310	5,616	9,207	19,540	11,455
2018	Circuit1598	243,584	154,594	58,207	152,128	204,655	108,660	99,288	137,534
2018	Circuit1599	3,748	2,261	638,355	214,788	748,689	51,267	1,169	267,042
2018	Circuit1600	620,115	14,492	11,385	215,331	150,741	27,080	23,571	67,130
2018	Circuit1601	241,601	47,943	206,881	165,475	133,782	663,491	120,346	305,873
2018	Circuit1602	8,803	7,692	13,323	9,939	10,229	14,081	3,616	9,309
2018	Circuit1603	44,802	8,845	2,683	18,777	37,465	12,729	902	17,032
2018	Circuit1604	473,090	342,222	12,112	275,808	30,620	11,206	17,485	19,770
2018	Circuit1605	377,053	25,082	38,090	146,742	63,180	137,247	242,746	147,724
2018	Circuit1606	20,041	129,708	57,521	69,090	288,304	374,759	9,213	224,092
2018	Circuit1607	48,218	60,459	14,033	40,903	87,975	28,902	15,257	44,045
2018	Circuit3741			929	929	-	-	-	-
2018	Circuit1219	18,596	38,679	2,073	19,783	130,958	70,729	18,613	73,433
2018	Circuit2015			27,795	27,795	870	38,717	10,617	16,735
2018	Circuit2016	21,000	2,284	210,057	77,780	33,857	249,159	34,863	105,960

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Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2017	417,220	787	289,500	235,836	16,166	288,937	14,698	106,600
2018	Circuit2019	20,664	852	1,522	7,679	10,970	5,524	16,446	10,980
2018	Circuit2020	353,107		12,682	182,895	13	1,363	49,012	16,796
2018	Circuit2021		2,392		2,392	-	0	0	-
2018	Circuit2022	819,923	68,038	66,725	318,229	116,831	54,965	50,869	74,221
2018	Circuit2023	812,354	17,661	68,357	299,457	156,340	15,595	87,846	86,594
2018	Circuit2024	342,762	19,643	1,038,747	467,051	3,415	199,611	24,356	75,794
2018	Circuit2025	671,822	15,932	404,248	364,001	26,425	4,589	918,421	316,478
2018	Circuit1622	29,737	19,738	44,138	31,204	165,037	101,062	812	88,970
2018	Circuit1623	87,701	62,013		74,857	5,595	57,632	4,827	22,684
2018	Circuit1624	130,845	47,576	460,679	213,033	316,907	357,394	11,295	228,532
2018	Circuit1625	832			832	-	581	2,048	877
2018	Circuit1626	25,748	1,522	36,703	21,324	117,754	44,743	2,625	55,041
2018	Circuit1627	11,310	1,105	17,200	9,872	152,552	50,226	52,934	85,237
2018	Circuit3728		6,497		6,497	-	-	-	-
2018	Circuit1629	3,181	14,734	6,736	8,217	1,667	64,796	28,186	31,550
2018	Circuit1630	103,382	10,803	174,476	96,220	12,420	27,468	4,514	14,801
2018	Circuit1631	7,663	141,100	17,025	55,263	14,433	9,751	65,942	30,042
2018	Circuit1632	57,020	29,977	29,790	38,929	39,761	25,346	42,063	35,723
2018	Circuit1633	41,278	173,964	228,409	147,884	5,632	14,771	56,750	25,718
2018	Circuit2559	53,064	1,488	8,867	21,140	55,431	25,822	12,811	31,355
2018	Circuit1634	11,171	117,740	3,998	44,303	38,593	45,383	11,762	31,913
2018	Circuit2566	512	51,271	40,679	30,821	24,128	52,338	14,039	30,168
2018	Circuit1392	119,873	46,037	4,506	56,805	56,733	0	0	18,911
2018	Circuit3761	84,618	25,567	560	36,915	-	-	-	-
2018	Circuit2578	113,347	43,315	235,244	130,635	1,340,107	123,261	16,517	493,295
2018	Circuit2579	3,790	28,695	31,431	21,305	206,858	50,728	128,875	128,820
2018	Circuit3730		123		123	-	-	-	-
2018	Circuit1237	3,332	21,830	881	8,681	195	33,516	5,591	13,101
2018	Circuit1238		234		234	-	0	0	-
2018	Circuit1239	1,811	3,545	5,429	3,595	10,827	18,330	20,051	16,403
2018	Circuit1240	6,835	61,972	23,184	30,664	41,217	3,059	49	14,775
2018	Circuit1242	2,065	90,252	14,122	35,480	88,915	17,416	1,178	35,836
2018	Circuit1243	3,007	78,155	41,841	41,001	25,588	36,951	2,116	21,552
2018	Circuit1244	8,635	160,218	3,713	57,522	100,151	2,063	8,382	36,866
2018	Circuit1245	3,686	5,932	8,821	6,146	3,097	4,560	22,986	10,214
2018	Circuit1246	13,169	5,265	51,883	23,439	27,276	23,151	3,860	18,096
2018	Circuit3710	234			234	-	-	-	-
2018	Circuit820	9,135		6,036	7,586	854	2,233	0	1,029
2018	Circuit825			2,505	2,505	7	0	312	106
2018	Circuit826		14,847	37,109	25,978	5	2,428	1,448	1,294
2018	Circuit827	6,264	351	18,855	8,490	17,068	12,420	381	9,956
2018	Circuit828	160,485	334,753	542,526	345,921	559,205	702,809	242,002	501,339
2018	Circuit829	153,531	45,160	1,318,522	505,738	422,710	345,395	20,294	262,799

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Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit830	103,526	132,143	393,347	209,672	515,086	145,515	40,690	233,764
2018	Circuit831	557	84	6,936	2,526	1,896	5,570	36	2,501
2018	Circuit832	141,936	216,834	404,062	254,277	71,095	437,587	67,955	192,212
2018	Circuit833	212,549	73,511	204,005	163,355	219,698	132,229	3,125	118,351
2018	Circuit834	16,249	6,055	169,569	63,958	13,208	68,653	175,589	85,817
2018	Circuit835	41,941	18,388	1,258,652	439,660	39,728	9,239	111,015	53,327
2018	Circuit836	121,744	23,261	275,382	140,129	302,596	64,724	17,459	128,260
2018	Circuit837	3,300	1,408	82,845	29,184	7,990	270	15,721	7,994
2018	Circuit838	330,831	79,153	588,199	332,728	198,566	351,731	41,103	197,133
2018	Circuit1641	10,410	6,161	6,216	7,596	3,920	8,623	13,873	8,805
2018	Circuit1646	84,579	14,778	123,656	74,338	39,050	50,597	10,661	33,436
2018	Circuit1642	340,497	41,771	179,899	187,389	15,861	207,321	12,758	78,647
2018	Circuit1647	356,809	17,895	1,000,085	458,263	114,847	466,580	15,920	199,115
2018	Circuit1643	136,177	85,430	293,844	171,817	25,820	33,175	10,225	23,073
2018	Circuit1648	492,779	144,686	15,646	217,704	438,320	64,245	39,071	180,545
2018	Circuit1644	97,609	210,452	78,880	128,980	511,344	418,278	36,420	322,014
2018	Circuit1645	31,062	138,614	65,880	78,519	84,123	5,929	43,213	44,422
2018	Circuit1649	107,404	85,899	35,358	76,220	128,649	25,227	27,913	60,597
2018	Circuit55	44,877	25,077	1,698,543	589,499	92,549	27,018	30,336	49,968
2018	Circuit57	6,547	101,226	224,573	110,782	87,738	17,975	19,174	41,629
2018	Circuit59	223,612	169,547	118,314	170,491	107,928	43,690	101,966	84,528
2018	Circuit60	58,024	463,462	503,241	341,576	48,281	48,976	45,072	47,443
2018	Circuit62	28,265	139,684	219,996	129,315	79,715	85,056	8,362	57,711
2018	Circuit63	59,797	615,938	265,119	313,618	419,080	47,546	46,951	171,192
2018	Circuit64	40,264	170,125	247,192	152,527	102,724	72,841	31,410	68,992
2018	Circuit3578	382,700	8,385	96,091	162,392	-	0	0	-
2018	Circuit2679				#DIV/0!	-	24	7,411	2,478
2018	Circuit2681				#DIV/0!	115	18,882	20,381	13,126
2018	Circuit3736			267,120	267,120	-	-	-	-
2018	Circuit3733		20		20	-	-	-	-
2018	Circuit1663	2,504	95,261	1,179	32,981	25,936	29,509	311,700	122,381
2018	Circuit1664	124,175	42,492	105,586	90,751	4,779	21,514	37,188	21,160
2018	Circuit1665	2,703	74,032	26,885	34,540	2,340	112,293	79,917	64,850
2018	Circuit1666	73,782	695,916	1,362,361	710,686	12,751	269,642	174,426	152,273
2018	Circuit1668	13,905	11,183	222,204	82,431	4,485	2,786	133,391	46,887
2018	Circuit1669	42,231	115,467	14,759	57,486	4,355	346,026	142,552	164,311
2018	Circuit852	126,023	418	22,170	49,537	30,572	52,569	4,605	29,249
2018	Circuit853	15,117	5,987	123,104	48,069	51,405	4,459	6,086	20,650
2018	Circuit854	125,811	20,375	392,422	179,536	72,408	134,250	138,140	114,933
2018	Circuit855	17,547	18,137	144,776	60,153	81,671	97,381	84,816	87,956
2018	Circuit856	199		2,095	1,147	-	0	0	-
2018	Circuit857	509,077	217,254	718,584	481,638	525,171	75,863	214,648	271,894
2018	Circuit858	486	6,360	45,874	17,573	24,476	2,107	0	8,861
2018	Circuit859	59,405	127,430	83,303	90,046	10,389	14,073	25,867	16,776

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Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3743			91	91	-	-	-	-
2018	Circuit860	91,904	71,293	377,357	180,185	789,665	150,765	201,755	380,729
2018	Circuit861	169,498	54,060	69,016	97,525	154,875	98,905	6,192	86,657
2018	Circuit862	31,133	128,755	19,651	59,846	19,603	3,032	28,744	17,126
2018	Circuit863	463,865	10,730	749,753	408,116	76,197	104,123	126,145	102,155
2018	Circuit864	604,410	1,322	2,131	202,621	48,019	637	3,789	17,482
2018	Circuit865	28,248	23,188	226,657	92,698	91,768	75,735	15,507	61,003
2018	Circuit3742			6	6	-	-	-	-
2018	Circuit3739			121	121	-	-	-	-
2018	Circuit3711	235			235	-	-	-	-
2018	Circuit1684	3,525	5,682	2,037	3,748	1,476	4,960	7,344	4,593
2018	Circuit1685	2,948	1,225	63,422	22,532	2,572	7,745	68,645	26,320
2018	Circuit1686	34,044	32,790	12,223	26,352	1,934	7,926	9,243	6,368
2018	Circuit1687	43,818	8,974	3,241	18,678	5,950	6,340	63,352	25,214
2018	Circuit1688	18,708	72,270	10,176	33,718	27,151	181,456	6,860	71,822
2018	Circuit2729			239	239	20	204	0	75
2018	Circuit2730	161			161	-	1,714	0	571
2018	Circuit2732				#DIV/0!	-	859	0	286
2018	Circuit2733	723	275		499	17	11	55,630	18,553
2018	Circuit2734	2,114	146,997	2,267	50,459	1,149	2,555	64,618	22,774
2018	Circuit2737	25,858	16,923	30,205	24,329	17,835	22,625	2,512	14,324
2018	Circuit2738	16,386	1,542	2,035	6,654	13,419	17,083	19,492	16,665
2018	Circuit2739	8,351	34,103	70,225	37,560	21,431	12,668	25,047	19,716
2018	Circuit2740	58,143	16,730	127,593	67,489	16,289	12,773	14,578	14,547
2018	Circuit2741	14,737	5,825	71,435	30,666	94,057	75,184	175,689	114,977
2018	Circuit2742	32,335	12,486	327,232	124,018	46,366	780,120	16,825	281,104
2018	Circuit2744	19,382	4,858	26,434	16,891	98,547	17,129	132,709	82,795
2018	Circuit2745	16,646	5,485	11,598	11,243	18,765	4,753	9,104	10,874
2018	Circuit2746	76,217	40,677	30,537	49,144	8,877	24,400	103,286	45,521
2018	Circuit2752	2,024	14,507	12,134	9,555	20,591	51,446	22,429	31,489
2018	Circuit2753	22,223	9,454	1,969	11,215	25,707	4,584	20,692	16,994
2018	Circuit2754	13,417	11,646	132,008	52,357	199,403	35,690	9,645	81,579
2018	Circuit2755	7,927	2,884	6,244	5,685	21,553	7,721	10,021	13,098
2018	Circuit2756	681	678	30,509	10,623	5,722	11,434	1,377	6,177
2018	Circuit4087		1,346		1,346	-	-	-	-
2018	Circuit875	129,665	51,811	69,591	83,689	160,949	202,544	184,072	182,522
2018	Circuit876	19,034	193,797	41,805	84,879	160,976	711,619	136,145	336,247
2018	Circuit3712	1,466			1,466	-	-	-	-
2018	Circuit3716	-		49	25	-	-	-	-
2018	Circuit1698	221,269	36,350	102,517	120,045	148,256	16,700	9,543	58,166
2018	Circuit3587	159,276	124,352	84,528	122,719	135,509	958	0	45,489
2018	Circuit1699	56,493	85,904	191,066	111,154	145,924	14,217	5,891	55,344
2018	Circuit1700	19,404	68,850	85,593	57,949	281,481	16,146	205,020	167,549
2018	Circuit1701	73,638	274,894	1,463,010	603,847	198,439	0	0	66,146

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Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3588	42,128	25,968	52,790	40,295	116,626	0	0	38,875
2018	Circuit2056		201	1,158	680	33	27	187	82
2018	Circuit2057			515	515	12	0	98	37
2018	Circuit2059	190,209	20,022	50,985	87,072	215,217	46,125	3,213	88,185
2018	Circuit2060	642	447,266	19,726	155,878	99,420	26,165	2,143	42,576
2018	Circuit2061	34,191	55,730	58,416	49,446	221,955	18,625	6,422	82,334
2018	Circuit2062	53,121	44,876	13,701	37,233	112,462	67,461	636	60,186
2018	Circuit4088			20	20	-	-	-	-
2018	Circuit1702	58,972	574,812	205,193	279,659	149,318	65,789	47,829	87,645
2018	Circuit1703	53,864	684,508	215,491	317,954	130,231	70,981	105,101	102,104
2018	Circuit1704	95,189	80,009	1,464,802	546,667	104,808	117,212	62,530	94,850
2018	Circuit2790	6,102	5,786	452,834	154,907	26,657	34,269	44,661	35,196
2018	Circuit2791	26,115	84,444	74,607	61,722	78,072	49,212	62,520	63,268
2018	Circuit2792	20,895	40,671	220,223	93,930	356,850	250,461	63,977	223,763
2018	Circuit2794	22,773	46,448	195,975	88,399	34,442	74,124	34,035	47,534
2018	Circuit2796		1,722	95	909	344	3,612	27	1,328
2018	Circuit2801	54,360	22,654	4,590	27,201	113,063	59,122	70,563	80,916
2018	Circuit2802	660			660	-	0	0	-
2018	Circuit2803	2,200			2,200	678	894	193	588
2018	Circuit2804	2,622	38,709	3,958	15,096	70,805	72,136	13,204	52,048
2018	Circuit2805	14,317	1,134	161,627	59,026	1,773	22,190	8,618	10,860
2018	Circuit2806	165	7,241	27,344	11,583	738	8,947	4,361	4,682
2018	Circuit2807	3,703	42,503	3,536	16,581	151,266	48,885	315	66,822
2018	Circuit2808	7,871	5,170	10,671	7,904	68,449	31,270	7,180	35,633
2018	Circuit2810	59	8,289	482	2,943	352	13,978	1,737	5,356
2018	Circuit879		281		281	520	676	3,364	1,520
2018	Circuit880		717		717	-	0	7	2
2018	Circuit882	265	805	762	611	-	0	0	-
2018	Circuit883	623			623	520	652	0	391
2018	Circuit884	1,232	295	1,742	1,090	157	0	147	101
2018	Circuit886	105	309	41,425	13,946	746	1,304	0	683
2018	Circuit887	26,299	5,100	9,656	13,685	147,700	290,752	6,146	148,199
2018	Circuit888	56,543	15,426	299,537	123,835	22,410	23,895	104,670	50,325
2018	Circuit889	64,448	211,368	141,062	138,959	464,519	142,525	107,798	238,281
2018	Circuit892	20,086	3,557	172,265	65,303	140,245	140,600	485,612	255,486
2018	Circuit893	4,299	67,339	62,181	44,606	49,325	6,900	2,475	19,566
2018	Circuit2063	4,386	92,881	111,718	69,662	108,179	262,152	16,642	128,991
2018	Circuit3718	416			416	-	-	-	-
2018	Circuit2067	12,625		8,149	10,387	5,785	2,619	972	3,126
2018	Circuit2068	18,106	81,559	134,656	78,107	340,796	65,873	170,544	192,404
2018	Circuit2069	139,903	7,858	6,496	51,419	298,532	51,005	178,683	176,073
2018	Circuit2070	112,372	10,656	108,084	77,037	200,668	92,479	42,225	111,791
2018	Circuit2071	164,123	14,698	39,092	72,638	17,350	156,723	27,150	67,074
2018	Circuit2072	41,516	6,932	20,297	22,915	24,452	24,555	2,532	17,180

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit3740			874	874	-	-	-	-
2018	Circuit2076	43,098	11,069	4,889	19,685	10,851	49,910	12,560	24,440
2018	Circuit2077	3,716	7,809	79,057	30,194	7,655	7,411	366,590	127,218
2018	Circuit2078	34,833	10,831	271,640	105,768	36,556	13,320	3,110	17,662
2018	Circuit2079		49	4,775	2,412	-	0	0	-
2018	Circuit2080	16,432	14,356	15,314	15,367	101,444	483	3,082	35,003
2018	Circuit2081	31,917	15,683	3,428	17,009	58,063	19,669	5,293	27,675
2018	Circuit2082	12,572	395,524	29,116	145,737	143,845	74,938	9,376	76,053
2018	Circuit895			153	153	32	1,172	50	418
2018	Circuit3622				#DIV/0!	-	-	-	-
2018	Circuit3643				#DIV/0!	-	0	1,103	368
2018	Circuit896				#DIV/0!	-	296	0	99
2018	Circuit3623		15,140	21,726	18,433	66,447	-	-	66,447
2018	Circuit897		2,460	3,964	3,212	113	1,886	0	666
2018	Circuit901	22,657	431	20,298	14,462	6,568	39	25,006	10,538
2018	Circuit903	9,298	6,843	8,730	8,290	7,782	60,980	8,684	25,815
2018	Circuit904	182,634	228,979	14,791	142,135	616,239	27,858	79,048	241,048
2018	Circuit3734		3,975	1,600	2,788	-	-	-	-
2018	Circuit1708	290,829	323,776	31,131	215,245	25,028	44,945	6,956	25,643
2018	Circuit1713	69,226	119,414	82,135	90,258	105,485	65,449	14,789	61,908
2018	Circuit1709	9,352	40,636	6,452	18,813	9,993	1,769	25,242	12,335
2018	Circuit1712	69,902	39,729	138,401	82,677	100,486	914	7,408	36,269
2018	Circuit1715	12,962	43,665	12,273	22,967	31,115	10,128	31,577	24,273
2018	Circuit2083	111,667	44,088	126,936	94,230	322,296	88,528	3,611	138,145
2018	Circuit2084	34,226	154,498	7,339	65,354	176,191	471,825	121,413	256,476
2018	Circuit2085	413,850	306,927	17,346	246,041	121,104	123,318	11,714	85,379
2018	Circuit2086		12,769	2,418	7,594	-	0	0	-
2018	Circuit3731		1,660		1,660	-	-	-	-
2018	Circuit2087	17,620	10,498	12,919	13,679	65,565	116,142	172,023	117,910
2018	Circuit2088	959,615	356,516	254,698	523,610	621,017	189,366	438,389	416,257
2018	Circuit910		2,122		2,122	-	0	0	-
2018	Circuit911		174		174	8,067	134	1,600	3,267
2018	Circuit912	2,115	2,092		2,104	4,874	840	584	2,100
2018	Circuit913	9,274	123,080	31,546	54,633	57,600	22,689	4,734	28,341
2018	Circuit916	4,146	736	49,698	18,193	82,190	5,816	965	29,657
2018	Circuit919	297,327	1,183,241	211,958	564,175	263,090	154,964	29,166	149,073
2018	Circuit1717	1,059	1,035	240	778	-	0	0	-
2018	Circuit1719				#DIV/0!	446	0	0	149
2018	Circuit1721	2,421			2,421	-	0	0	-
2018	Circuit1727		5,004	385	2,695	98	5,165	25	1,763
2018	Circuit1728	27,370	1,566	15,260	14,732	970	1,191	14,484	5,548
2018	Circuit1729		385		385	1,053	23	157	411
2018	Circuit1730	894	502	1,696	1,031	1,928	396	917	1,080
2018	Circuit1732	163,228	226,768	188,790	192,929	23,213	59,083	38,653	40,317

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1733	629,785	272,605	83,239	328,543	70,474	115,344	23,807	69,875
2018	Circuit1734	668,971	140,223	188,095	332,430	12,281	657,575	16,511	228,789
2018	Circuit1735	634,915	157,642	120,968	304,508	168,746	39,220	5,492	71,153
2018	Circuit1736	836,980	18,510	137,713	331,068	38,667	93,298	31,549	54,504
2018	Circuit1737	302,178	18,853	72,956	131,329	26,842	11,990	105,976	48,269
2018	Circuit1738	369,270	64,808	48,274	160,784	126,048	46,518	134,927	102,498
2018	Circuit1739	209,926	10,054	35,422	85,134	123,620	17,001	23,432	54,684
2018	Circuit933	6,915	21,520	5,599	11,345	46,610	22,612	2,823	24,015
2018	Circuit934	34,624	5,774	28,889	23,096	208,595	27,079	227,452	154,375
2018	Circuit935	92,004	6,414	95,023	64,480	11,653	67,300	54,311	44,421
2018	Circuit936	9,954	11,835	312,427	111,405	10,597	5,787	16,044	10,809
2018	Circuit937	111,655	31,822	53,349	65,609	371,884	33,058	19,876	141,606
2018	Circuit938	30,006	35,300	150,795	72,034	54,250	32,927	19,292	35,490
2018	Circuit939	91,361	487,935	76,258	218,518	286,781	11,837	36,142	111,587
2018	Circuit2859	106,175	494,474	33,109	211,253	38,926	5,699	2,837	15,821
2018	Circuit1401	3,731	3,699	44,831	17,420	2,292	52,709	27,668	27,556
2018	Circuit1402	23,512	60,907	119,449	67,956	247,330	78,355	142,570	156,085
2018	Circuit3738			35	35	-	-	-	-
2018	Circuit2862	32,418		3,869	18,144	103	247	6,814	2,388
2018	Circuit2863	8,408	433	9,171	6,004	-	711	880	530
2018	Circuit2864	345	49,580	1,457	17,127	52,965	897	17,259	23,707
2018	Circuit2865	99,191	21,642	3,871	41,568	170,446	174,790	19,713	121,650
2018	Circuit2866	26,390	97,021	42,556	55,322	23,102	65,403	135,876	74,794
2018	Circuit2868	163,982	1,839	2,737	56,186	27,664	84,970	25,251	45,962
2018	Circuit2869	7,727	53,049	102,923	54,566	35,031	7,948	17,578	20,186
2018	Circuit2870	58,556	220,306	74,235	117,699	68,170	136,723	109,511	104,801
2018	Circuit2877	4,437	8,315	217,461	76,738	97,527	104,524	132,659	111,570
2018	Circuit2878			166,383	166,383	-	0	0	-
2018	Circuit2879		76,126	24,531	50,329	40,747	56,680	10,792	36,073
2018	Circuit2881	213,471	83,159	67,906	121,512	134,944	104,444	11,854	83,747
2018	Circuit2882	2,282	53,604	7,029	20,972	21,715	19,090	2,087	14,298
2018	Circuit2884	5,282	305,297	822	103,800	46,283	61,369	4,681	37,444
2018	Circuit2885	8,218	11,356	27,613	15,729	147,854	112,551	113,762	124,722
2018	Circuit2886	13,505	55,873	141,972	70,450	3,149	13,925	8,352	8,475
2018	Circuit2887	4,089	7,729	67,538	26,452	179,602	164,364	10,281	118,082
2018	Circuit2888	1,023	3,507	4,805	3,112	133,084	214,979	11,081	119,715
2018	Circuit2889	46,212	114,030	3,977	54,740	68,666	17,776	94,278	60,240
2018	Circuit2890	2,065	55,771	12,780	23,539	84,437	9,653	3,678	32,589
2018	Circuit2894	108,492	59,314	82,101	83,302	9,395	13,856	384,696	135,982
2018	Circuit2895	31,034	10,412	3,695	15,047	7,798	13,241	51,338	24,126
2018	Circuit1740	796			796	406	269	530	402
2018	Circuit1741	443,446	57,817	22,491	174,585	194,773	11,960	192,306	133,013
2018	Circuit1743	1,082,183	20,889	467,433	523,502	1,221,836	413,837	279,769	638,481
2018	Circuit1745	320,097	232,218	7,372	186,562	67,857	4,527	124,344	65,576

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1746	409,401	90,931	539,259	346,530	270,968	24,392	280,789	192,050
2018	Circuit1748	310,347	158,256	30,209	166,271	184,129	32,340	145,335	120,601
2018	Circuit1749	368,987	13,792	33,405	138,728	94,044	144,892	451,472	230,136
2018	Circuit1750	426,575	68,879	102,897	199,450	309,996	152,900	183,627	215,508
2018	Circuit1751	403,036	8,848	464,529	292,138	234,555	96,392	183,144	171,364
2018	Circuit3727	58	186		122	-	-	-	-
2018	Circuit3719	112			112	-	-	-	-
2018	Circuit3590	576		1,010	793	2,433	0	0	811
2018	Circuit3591	3,604	5,017	1,240	3,287	2,204	0	0	735
2018	Circuit3592	100,880	239,619	31,402	123,967	101,000	0	0	33,667
2018	Circuit3594	164,225	95,172	1,422	86,940	8,438	0	0	2,813
2018	Circuit3595	177,622	175,405	79,752	144,260	220,166	0	0	73,389
2018	Circuit1752	52,084	4,420	9,828	22,111	13,265	2,734	20,024	12,008
2018	Circuit1753	11,498	8,081	14,270	11,283	4,481	15,777	16,253	12,170
2018	Circuit1759	19,809	129,070	10,534	53,138	21,933	98,558	34,793	51,761
2018	Circuit1754	243,207	7,186	189,954	146,782	4,082	46,573	210,477	87,044
2018	Circuit1755	20,521	274	85,962	35,586	8,396	3,523	7,607	6,509
2018	Circuit1756	81,596	9,632	6,733	32,654	535,306	8,578	83,046	208,977
2018	Circuit940		22,388		22,388	-	0	0	-
2018	Circuit941	177	9,105	17,892	9,058	7,367	2,775	655	3,599
2018	Circuit942				#DIV/0!	2,216	0	0	739
2018	Circuit943	29,983	1,250	49,353	26,862	138,688	2,500	1,387	47,525
2018	Circuit2932	41,641	6,040	53,132	33,604	238,997	33,215	84,307	118,840
2018	Circuit2933	102,945	316,395	474,141	297,827	44,865	96,472	24,338	55,225
2018	Circuit2934	343,784	38,139	33,351	138,425	27,153	54,465	62,414	48,011
2018	Circuit2935	24,399	36,366	17,166	25,977	245,868	89,080	221,679	185,542
2018	Circuit2936	3,732	3,250	2,350	3,111	46,013	22,863	15,525	28,134
2018	Circuit2937	27,045	1,102	3,572	10,573	36,501	47,943	31,221	38,555
2018	Circuit1250		5,728	995	3,362	15	197	1,041	418
2018	Circuit1252	102,318	5,723	17,288	41,776	8,757	21,594	2,757	11,036
2018	Circuit1253	336,761	50,914	55,892	147,856	21,848	50,770	38,779	37,132
2018	Circuit1255	373,618	2,540	19,222	131,793	32,154	5,023	500,305	179,160
2018	Circuit1256	459,238	16,892	449,523	308,551	22,367	16,022	320,897	119,762
2018	Circuit1257	40,324	7,896		24,110	22,302	7,268	107	9,893
2018	Circuit944	125,804	95,625	3,826	75,085	19,295	102,324	175,584	99,068
2018	Circuit945	3,923			3,923	63	127	596	262
2018	Circuit946	970	63,600	7,878	24,149	26,292	26,845	25,582	26,240
2018	Circuit947		15,089	105	7,597	15,630	19,808	81,175	38,871
2018	Circuit3649				#DIV/0!	-	0	0	-
2018	Circuit1766	24,388	365,306	205,468	198,387	1,453	3,667	3,688	2,936
2018	Circuit1768	1,612	47,109	763	16,495	7,019	32,654	44,713	28,129
2018	Circuit1769	132,595	277,425	2,070	137,363	1,222	454	417,183	139,620
2018	Circuit1771				#DIV/0!	10	0	0	3
2018	Circuit1772	14,742	247,664	7,746	90,051	50,137	5,156	81,784	45,692

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1773	83,180	4,223	307,020	131,474	23,851	70,329	66,725	53,635
2018	Circuit1774	27,700	17,029	241,928	95,552	19,129	27,716	17,805	21,550
2018	Circuit2971	237,374	4,258	190,032	143,888	200,869	104,052	39,649	114,857
2018	Circuit2973	1,805	6,950	795	3,183	58,187	16,438	167,215	80,613
2018	Circuit948		227		227	-	0	0	-
2018	Circuit950	29,499	34,133	170,298	77,977	35,327	4,916	37,456	25,900
2018	Circuit951	809,412	98,358	30,797	312,856	153,445	195,131	32,994	127,190
2018	Circuit952	24,870	38,433	243,841	102,381	34,922	17,187	22,674	24,928
2018	Circuit953	148,449	80,420	102,413	110,427	98,574	25,483	30,493	51,517
2018	Circuit954	168,691	107,716	445,752	240,720	440,765	80,620	149,621	223,669
2018	Circuit955	208,549	90,588	55,752	118,296	174,158	103,331	137,568	138,352
2018	Circuit4089	1,701			1,701	-	-	-	-
2018	Circuit2993			1,059	1,059	6	696	0	234
2018	Circuit2994	6,552	38,770	5,059	16,794	36	5,670	8,164	4,623
2018	Circuit2995	15,793	685,006	180,019	293,606	42,099	8,073	25,043	25,072
2018	Circuit2996	22,309	551,338	54,195	209,281	235,881	43,419	42,185	107,162
2018	Circuit2997	4,639	382,104	80,730	155,824	8,407	9,597	618,216	212,073
2018	Circuit2998	20,927	867,919	66,080	318,309	26,474	52,182	53,097	43,918
2018	Circuit2999	5,110	573,451	100,081	226,214	643,431	110,083	48,411	267,308
2018	Circuit3737			899	899	-	-	-	-
2018	Circuit957	78,778	1,654	26,135	35,522	142,669	135,877	12,873	97,140
2018	Circuit958	195,655	67,833	221,020	161,503	108,765	-	-	108,765
2018	Circuit960	319,620	13,961	508,254	280,612	1,013,887	86,608	18,738	373,078
2018	Circuit3598		400		400	64,669	0	0	21,556
2018	Circuit3041	45,361	5,343	552	17,085	40,966	4,016	219,164	88,049
2018	Circuit3056	5,392	1,336	3,610	3,446	16,699	318	1,184	6,067
2018	Circuit3064	197,373	76,592	29,719	101,228	3,009	5,614	26,237	11,620
2018	Circuit3065	136,896	219,910	130,562	162,456	11,014	154,521	180,263	115,266
2018	Circuit3066	192,043	13,002	159,231	121,425	17,082	35,480	128,841	60,468
2018	Circuit3069				#DIV/0!	-	190	21	70
2018	Circuit1779	7,341	209,404	284,341	167,029	4,671	43,413	64,182	37,422
2018	Circuit3070	29,637	7,736	80,375	39,249	2,764	27,408	36,373	22,182
2018	Circuit3071	16,101	195,833	5,050	72,328	875,237	449,629	7,914	444,260
2018	Circuit3072	40,979	4,278	20,023	21,760	11,411	53,203	3,569	22,728
2018	Circuit3073	195,996	318,760	79,099	197,952	153,523	2,173	341,806	165,834
2018	Circuit3074	136,700	770	8,227	48,566	81,128	2,490	9,554	31,057
2018	Circuit1780	9,661	21,561	16,500	15,907	3,878	126,714	292,914	141,169
2018	Circuit1782	2,133			2,133	2,220	141	6,130	2,830
2018	Circuit1783	4,480			4,480	1,864	1,970	3,280	2,372
2018	Circuit1785	248	1,141	2,743	1,377	105	345	26,187	8,879
2018	Circuit1788		17,185		17,185	1,888	727	1,307	1,308
2018	Circuit1789	272,465	70,074	34,681	125,740	261,651	107,132	119,051	162,611
2018	Circuit1790	215,964	124,226	83,879	141,356	93,519	1,771	209,474	101,588
2018	Circuit1791	77,773	3,536	5,189	28,833	13,790	49,973	19,894	27,886

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1792	201,531	36,366	293,704	177,200	317,629	269,391	176,374	254,465
2018	Circuit1793	31,088	8,571	8,605	16,088	459	33,803	642,448	225,570
2018	Circuit1794	1,097,511	168,137	110,523	458,724	808,676	306,508	217,192	444,125
2018	Circuit1795	22,530	872		11,701	-	974	17,452	6,142
2018	Circuit3657	353	11,768	444	4,188	-	0	0	-
2018	Circuit3606	598	1,247	135	660	1,763	0	0	588
2018	Circuit3607	244	1,511		878	-	0	0	-
2018	Circuit3608	18,240	471		9,356	104	476	0	193
2018	Circuit3609	2,613			2,613	1,586	6	0	531
2018	Circuit3660				#DIV/0!	243	0	0	81
2018	Circuit3713	410,961			410,961	-	-	-	-
2018	Circuit3662				#DIV/0!	-	99	0	33
2018	Circuit3663	1,779	312	1,404	1,165	-	0	0	-
2018	Circuit3611	5,260	116,235	26,520	49,338	33,202	1,022	58	11,428
2018	Circuit3714	48,544	923,739		486,142	-	-	-	-
2018	Circuit3096	2,617	66,825		34,721	7,499	2,004	10,724	6,742
2018	Circuit3097	65,862	232,289	66,891	121,681	123,333	261,453	295,977	226,921
2018	Circuit3099	270,076	218,855	33,917	174,283	281,805	303,144	99,920	228,290
2018	Circuit3100	8,370	17,506	46,026	23,967	94,778	74,989	215,421	128,396
2018	Circuit3101	44,429	44,746	819,270	302,815	264,080	373,769	225,064	287,638
2018	Circuit3102	14,409	20,280	13,534	16,074	133,528	168,493	1,278	101,100
2018	Circuit1798	80,192	77,736	199,974	119,301	661,371	78,156	197,061	312,196
2018	Circuit1799	209,391	35,812	158,577	134,593	219,402	162,856	41,294	141,184
2018	Circuit1800	250,805	24,022	25,490	100,106	163,244	37,109	303,011	167,788
2018	Circuit1801	44,996	12,552	294,939	117,496	191,755	32,333	48,969	91,019
2018	Circuit1802	1,120,652	77,097	104,802	434,184	863,990	192,855	12,404	356,416
2018	Circuit1803	1,325	297	2,468	1,363	3,915	190	2,719	2,275
2018	Circuit1804	200,926	12,912	61,786	91,875	439,014	17,220	90,846	182,360
2018	Circuit1805	203			203	1,125	0	0	375
2018	Circuit1806	61,615	2,821	5,575	23,337	562	9,067	0	3,210
2018	Circuit1807	3,360			3,360	118	142	0	87
2018	Circuit1809	6,134	3,296	43,272	17,567	70,151	5,173	19,310	31,545
2018	Circuit3124	402	7,121		3,762	3,972	3,709	1,569	3,083
2018	Circuit3126	230	282	13,860	4,791	182	258	0	147
2018	Circuit3131	17,474	87,375	37,719	47,523	42,388	28,919	130,378	67,228
2018	Circuit4090			258	258	-	-	-	-
2018	Circuit1812	1,995	177	940	1,037	9,170	1,063	11,793	7,342
2018	Circuit1815	325		2,363	1,344	5,900	1,285	254	2,480
2018	Circuit1816				#DIV/0!	67	230	0	99
2018	Circuit1817				#DIV/0!	-	6	195	67
2018	Circuit1818	4,260	821	1,138	2,073	553	0	0	184
2018	Circuit1819	921	10,962	2,034	4,639	5,894	3,740	3,549	4,394
2018	Circuit1820	91,007	27,823	96,511	71,780	70,400	51,376	35,201	52,325
2018	Circuit1821	213,555	3,465	545,129	254,050	393,696	420,795	1,012	271,834

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Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1822	1,421	20,852	6,227	9,500	37,647	3,347	2,711	14,568
2018	Circuit1823	7,160	146,297	3,275	52,244	271,891	475,360	50,183	265,812
2018	Circuit1824	14,215	1,191,924	31,758	412,632	101,210	368,741	139,004	202,985
2018	Circuit1825	65,004	501,917	484,533	350,485	504,024	64,831	60,928	209,928
2018	Circuit1826	2,968	363,101	74	122,048	363,598	10,115	11,727	128,480
2018	Circuit3156				#DIV/0!	-	94	0	31
2018	Circuit1265	2,860	613	482	1,318	11,526	-	-	11,526
2018	Circuit1266				#DIV/0!	1,988	549	0	846
2018	Circuit1268		39		39	-	70	0	23
2018	Circuit1271	7,850	237		4,044	40	5,960	319	2,106
2018	Circuit1272	1,770			1,770	367	13	321	234
2018	Circuit1274	150,850	55,561	20,690	75,700	61,472	71,309	8,897	47,226
2018	Circuit1275	106,438	216,712	258,850	194,000	47,996	30,031	157,587	78,538
2018	Circuit1276	135,489	27,824	25,177	62,830	13,270	5,004	3,120	7,131
2018	Circuit1827	38,361	1,922	145	13,476	3,503	141,148	336,707	160,453
2018	Circuit1828	230,230	57,237	55,710	114,392	56,128	73,661	10,636	46,808
2018	Circuit1829	123,904	38,770	1,816	54,830	54,863	120,507	3,369	59,580
2018	Circuit1830	33,047	25,287	66,772	41,702	96,290	9,581	316,067	140,646
2018	Circuit3184	1,217	1,834	3,232	2,094	1,989	1,300	278	1,189
2018	Circuit3185	280,037	100	6,067	95,401	529,922	427,659	25,922	327,834
2018	Circuit3186	135,376	1,945	5,449	47,590	110,650	398,038	10,601	173,096
2018	Circuit3187	17,438	123,930	323,628	154,999	7,318	25,653	66,570	33,180
2018	Circuit3188	7,087	3,702	4,521	5,103	167,394	46,047	119,737	111,059
2018	Circuit3189		563,655	84	281,870	-	0	0	-
2018	Circuit3190	8,022	123,207	4,687	45,305	2,063	1,715	30,025	11,268
2018	Circuit3192	4,817	18,036	27,373	16,742	155,304	289,371	26,318	156,998
2018	Circuit3193	2,453	7,950	22,547	10,983	134,736	183,217	72,681	130,211
2018	Circuit3194	6,366	81,539	35,026	40,977	749,798	89,743	13,820	284,454
2018	Circuit3195	187,190	21,877	89,391	99,486	85,714	172,837	66,143	108,231
2018	Circuit1839	54,302	20,279	10,832	28,471	6,830	30,336	1,028,010	355,059
2018	Circuit1845	1,598	33,153	172,234	68,995	27,479	10,181	44,679	27,446
2018	Circuit1846	10,221	22,925	30,568	21,238	76,303	48,896	11,641	45,613
2018	Circuit1847		-	6,652	3,326	-	70,539	9,538	26,692
2018	Circuit1848	16,539	3,412	85,053	35,001	3,121	56,317	96,078	51,839
2018	Circuit1849	11,728	11,491	117,264	46,828	354,211	6,356	2,229	120,932
2018	Circuit1850			38	38	-	20	252	90
2018	Circuit1851	9,413	11,052	207,170	75,878	79,526	215,969	30,151	108,549
2018	Circuit1852	1,591	1,666	9,393	4,217	166	54	17	79
2018	Circuit1853	3,708	2,374	848	2,310	22,975	1,509	11,163	11,882
2018	Circuit1854	32,655	123,831	12,338	56,275	38,560	12,772	39,600	30,311
2018	Circuit1433	97,084	16,202	120,316	77,867	134,632	14,412	63,634	70,893
2018	Circuit1434	76,349	19,076	158,325	84,583	255,031	29,368	148,126	144,175
2018	Circuit1435	120,287	486,960	98,044	235,097	247,913	70,451	67,264	128,543
2018	Circuit1436	39,914	98,437	43,697	60,683	71,361	26,219	35,162	44,247

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2145	3,638	15,696	3,295	7,543	1,953	26,536	205,633	78,041
2018	Circuit2146	20,099	56,363	569,031	215,164	24,995	22,444	344,968	130,803
2018	Circuit2147	3,427	21,156	21,510	15,364	45,917	3,655	711,638	253,737
2018	Circuit1300	22,201	9,850	3,313	11,788	53,683	413,009	38,433	168,375
2018	Circuit1301	167,851	29,088	44,079	80,339	77,127	649,430	7,175	244,577
2018	Circuit1302	165,593	5,030	5,358	58,660	15,926	337,327	46,809	133,354
2018	Circuit4091	1,512			1,512	-	-	-	-
2018	Circuit1303	10,253	4,273	226,838	80,455	23,399	385,841	2,266	137,169
2018	Circuit1295	56,696	32,560	473,650	187,635	18,836	253,560	575	90,990
2018	Circuit1297	815	3,744	14,721	6,427	72,158	204,353	0	92,170
2018	Circuit1304	110,370	19,522	13,129	47,674	168,772	12,730	6,423	62,642
2018	Circuit1306	182,820	4,715	17,502	68,346	93,536	310,014	3,450	135,667
2018	Circuit1298	69,090	4,696	8,920	27,569	30,145	134,689	22,631	62,488
2018	Circuit3717	150			150	-	-	-	-
2018	Circuit3735			1,903	1,903	-	-	-	-
2018	Circuit975	410	156		283	11	1,797	1,899	1,236
2018	Circuit978	37,117		1,092	19,105	17,191	9,206	6,951	11,116
2018	Circuit3677		158		158	-	0	0	-
2018	Circuit982			64	64	-	0	45	15
2018	Circuit986			419	419	323	1,539	515	792
2018	Circuit987	51,443	971	3,765	18,726	203,033	0	20,992	74,675
2018	Circuit988	42,351	48,999	501,945	197,765	20,347	16,421	23,492	20,087
2018	Circuit989	24,502	20,477	598,794	214,591	80,569	187,017	172,490	146,692
2018	Circuit991	16,294	4,238	182,784	67,772	45,580	14,663	68,947	43,063
2018	Circuit992	24,960	11,658	34,748	23,789	34,148	11,033	107,577	50,919
2018	Circuit994	193,496	416,175	747,182	452,284	1,068,937	399,586	662,386	710,303
2018	Circuit995	189,099	741,538	351,775	427,471	453,245	58,862	122,648	211,585
2018	Circuit1878	201,152	19,192	35,834	85,393	20,892	42,949	19,217	27,686
2018	Circuit1879	6,653			6,653	358	5,105	814	2,092
2018	Circuit1880	333,509	28,863	1,966	121,446	95,920	9,259	742,999	282,726
2018	Circuit2150	131,518	717,133	282,320	376,990	452,959	133,497	63,745	216,734
2018	Circuit3721	545			545	-	-	-	-
2018	Circuit3314	135	6,832		3,484	-	10	0	3
2018	Circuit3316	3,298	1,698	4,195	3,064	3,253	2,897	7,684	4,611
2018	Circuit3317	133,748	19,128	3,892	52,256	42,660	3,271	2,029	15,987
2018	Circuit3318	5,626	53,779	9,077	22,827	1,610	345	1,096	1,017
2018	Circuit3319	6,318	85,187	1,553	31,019	11,255	7,749	1,773	6,925
2018	Circuit3320	9,745	4,088	28,698	14,177	21,111	12,555	36,285	23,317
2018	Circuit3321	13,415	19,836	2,138	11,796	32,268	20,517	37,206	29,997
2018	Circuit3322	2,508	4,096	923	2,509	291	1,240	6,369	2,633
2018	Circuit3323	13,425	1,836	8,354	7,872	576	113,598	13,428	42,534
2018	Circuit3324	1,400	4,385	2,315	2,700	36,897	27,883	5,273	23,351
2018	Circuit1455				#DIV/0!	2,035	1,669	0	1,235
2018	Circuit2167	123,248	12,195	22,235	52,559	1,814	1,105	6,701	3,207

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		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit2165	3,839	114,146	13,493	43,826	475,850	113,364	4,041	197,752
2018	Circuit2166	112,678	31,922	18,593	54,398	74,365	2,621	8,687	28,558
2018	Circuit1307		287		287	71	285	0	119
2018	Circuit1308	869	5,726	293	2,296	1,560	755	0	772
2018	Circuit1309	350		1,619	985	1,051	4,974	1,523	2,516
2018	Circuit1310				#DIV/0!	198	0	183	127
2018	Circuit1311			1,225	1,225	1,267	6,572	3,683	3,841
2018	Circuit1312				#DIV/0!	-	0	3,016	1,005
2018	Circuit1313	7,462	5,210	19,609	10,760	22,441	64,235	1,339	29,338
2018	Circuit3395	56,826	42,234	78,591	59,217	336,086	126,709	68,298	177,031
2018	Circuit3397	13,862	1,007	14,561	9,810	45,073	21,895	25,299	30,756
2018	Circuit3398	4,840	5,794	100,476	37,037	8,461	32,121	17,745	19,442
2018	Circuit3399				-	-	20	1,218	-
2018	Circuit3400	4,118	213,309	226,102	147,843	67,639	238,156	32,630	112,808
2018	Circuit1458	1,219	182,096	371,832	185,049	206,964	3,577	1,823	70,788
2018	Circuit1459	3,128	488,280	392,267	294,558	104,153	10,075	2,647	38,958
2018	Circuit1460	12,303	256,830	132,646	133,926	172,363	9,399	1,130	60,964
2018	Circuit1461				-	152	0	0	-
2018	Circuit1462	1,171	21,103	3,420	8,565	33,717	2,463	15,856	17,345
2018	Circuit1463	76,978	171,085	11,570	86,544	70,237	2,409	3,694	25,447
2018	Circuit1464	47,342	34,941	11,148	31,144	106,134	5,114	5,464	38,904
2018	Circuit3724	968			968	-	-	-	-
2018	Circuit1907	708	592		650	364	112	170	216
2018	Circuit1908	11,406	977		6,192	25,911	15,728	0	13,880
2018	Circuit1910	62,455	9,572	7,876	26,634	161,736	156,383	9,298	109,139
2018	Circuit1912	1,429,256	85,637	47,989	520,961	880,861	154,392	29,390	354,881
2018	Circuit1916	449	1,534		992	-	2,662	0	887
2018	Circuit1917	1,094			1,094	-	0	0	-
2018	Circuit1918	4,078	81,894	8,833	31,602	34,917	136,049	14,827	61,931
2018	Circuit1919	111	32,469	2,652	11,744	408,099	469	4,960	137,843
2018	Circuit1920		5,518	75,329	40,424	-	0	0	-
2018	Circuit1921	193,843	170,313	341,267	235,141	195,848	124,626	7,497	109,324
2018	Circuit1922	1,105,939	30,894	118,879	418,571	1,228,497	690,510	5,679	641,562
2018	Circuit1923			40	40	-	0	0	-
2018	Circuit1924	112,436	118,099	505,676	245,404	373,834	92,059	879	155,591
2018	Circuit1925	5,980	280,321	89,923	125,408	221,047	632,588	5,907	286,514
2018	Circuit1926	4,121	14,123	3,698	7,314	18,507	4,672	4,789	9,323
2018	Circuit1009	269,625	107	2,997	90,910	3,094	19,633	79,566	34,098
2018	Circuit1010	78,063	17,505	159,215	84,928	169,843	85,152	74,586	109,860
2018	Circuit1011	11,528	3,147	3,886	6,187	2,560	6,280	26,636	11,825
2018	Circuit1012	8,839	886	26,691	12,139	89,209	43,139	104,738	79,029
2018	Circuit1013	1,804	3,762	214,338	73,301	126,542	28,005	176,636	110,394
2018	Circuit1014	4,588	1,820	6,192	4,200	106,246	6,911	80,005	64,387
2018	Circuit1016	7,410	102,648	730,789	280,282	77,457	169,444	292,952	179,951

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Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	Circuit1017	16,290	6,563	173,025	65,293	21,964	198,867	746,022	322,284
2018	Circuit1018	1,407	1,771	3,095	2,091	87,523	85,242	6,843	59,869
2018	Circuit1019	25,570	6,090	248,968	93,543	20,751	30,435	9,823	20,337
2018	Circuit1022	6,152	20,240	521,134	182,509	22,769	177,399	36,031	78,733
2018	Circuit1023	628,896	593	19,478	216,322	151,180	4,729	55,078	70,329
2018	Circuit3732		11,020		11,020	-	-	-	-
2018	Circuit1927	21,437	5,182	2,052	9,557	1,753	2,251	1,984	1,996
2018	Circuit1928	30,825	2,500	7,310	13,545	5,807	5,012	40,147	16,988
2018	Circuit1936		249	1,004	627	44	0	1,439	494
2018	Circuit1938		339		339	-	0	55	18
2018	Circuit1939	11,374	19,018	135,111	55,168	335,692	32,131	45,258	137,694
2018	Circuit1940	352,807	206,285	1,230,705	596,599	228,820	81,937	72,084	127,614
2018	Circuit1941	229,455	104,966	36,074	123,498	140,261	846,397	185,851	390,836
2018	Circuit1024	1,583	6,855	29,538	12,659	9,942	2,679	617	4,412
2018	Circuit1026	4,252	101	1,488	1,947	983	706	53,921	18,537
2018	Circuit1028		1,110	3,286	2,198	54,662	192	19,817	24,890
2018	Circuit1029	344	2,448	378	1,057	1,616	2,560	2,682	2,286
2018	Circuit1030	1,277	356		817	968	9	97,352	32,776
2018	Circuit1031				#DIV/0!	-	0	91	30
2018	Circuit1032	4,295	1,303	139	1,912	281	16,023	64	5,456
2018	Circuit1033	28,152	141	1,286	9,860	4,906	0	333	1,746
2018	Circuit1034	522		758	640	4,432	0	693	1,708
2018	Circuit3725	85			85	-	-	-	-
2018	Circuit3726	97			97	-	-	-	-
2018	Circuit1038	19,075	21,870	15,395	18,780	306,798	10,976	16,674	111,483
2018	Circuit1037	8,317	1,445	38	3,267	-	0	0	-
2018	Circuit3729		163,712	7,222	85,467	-	-	-	-
2018	Circuit3484	51,781	16,216	3,690	23,896	63	10,550	5,791	5,468
2018	Circuit3722	501	85		293	-	-	-	-
2018	Circuit3486	2,023	9,648	8,911	6,861	454	0	1,233	562
2018	Circuit3487	1,557	15,646	2,250	6,484	26,569	993	16,779	14,780
2018	Circuit3488		8,088	278	4,183	845	1,442	217	835
2018	Circuit3489				#DIV/0!	34,142	84,918	93,432	70,831
2018	Circuit3490		136,458	12,350	74,404	24,805	251,853	264,742	180,467
2018	Circuit3690	49,918	2,188	1,430	17,845	-	-	-	-
2018	Circuit3491	39,742	212,043	82,515	111,433	160,527	91,941	55,544	102,671
2018	Circuit3492	3,924	105,307	78,996	62,742	12,769	8,604	16,614	12,662
2018	Circuit3493	42,000	181,353	28,699	84,017	81,467	404,909	41,766	176,047
2018	Circuit3495	3,708	4,233	18,435	8,792	10,866	138,745	6,243	51,951
2018	Circuit3496	91,007	93,563	941	61,837	14,349	5,551	381,925	133,942
2018	Circuit3497	126,292	16,639	117,362	86,764	126,839	39,300	192,853	119,664
2018	Circuit3498	5,491	23,200	70,347	33,013	31,051	432,169	6,396	156,539
2018	Circuit3499	28,099	32,986	12,554	24,546	5,447	16,498	26,474	16,140
2018	Circuit3501	46,113	18,824	225,442	96,793	18,302	117,261	237,364	124,309

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2018	Circuit3502	473,223	231,935	241,252	315,470	186,516	322,488	46,482	185,162
2018	Circuit3503	11,988	35,954	9,164	19,035	10,026	197,284	81,370	96,227
2018	Circuit3509	4,548	1,663	246,345	84,185	49,843	15,392	132,108	65,781
2018	Circuit3510	170,516	106,981	45,369	107,622	48,106	48,477	21,818	39,467
2018	Circuit3511	4,135	37,565	3,950	15,217	7,061	126,833	293,423	142,439
2018	Circuit3513	5,734	272		3,003	4,660	439	4,661	3,253
2018	Circuit3723	478			478	-	-	-	-
2018	Circuit3535		718		718	-	0	0	-
2018	Circuit3686	27,756	9,602	257	12,538	-	0	0	-
2018	Circuit3536				#DIV/0!	-	0	205	68
2018	Circuit3537	1,667		4,531	3,099	10,030	409	1,284	3,908
2018	Circuit3688				#DIV/0!	-	0	0	-
2018	Circuit3619	11,788	14,439	35,599	20,609	49,563	0	0	16,521
2018	Circuit3621	17,175	43,055	463,431	174,554	63,289	0	0	21,096
2018	Circuit1047	45,626	9,144	3,885	19,552	183,606	21,661	18,829	74,699
2018	Circuit1048	167,624	41,898	40,805	83,442	18,842	64,831	21,434	35,036
2018	Circuit2376				#DIV/0!	-	142,408	20,515	54,308
2018	Circuit1049	646,187	13,226	138,395	265,936	4,665	86,949	12,063	34,559
2018	Circuit2377				#DIV/0!	867	558,743	131,167	230,259
2018	Circuit2378				#DIV/0!	1,514	92,579	87,503	60,532
2019	Circuit3715	303	103		203		-	-	#DIV/0!
2019	Circuit3720		52		52		-	-	#DIV/0!
2019	Circuit206	2,011	184,029	17,046	67,695	239,756	2,500	161,685	134,647
2019	Circuit208	5,780	47,375	664	17,940	402,181	12,249	791	138,407
2019	Circuit211	27,993	91,615	43,484	54,364	778,975	14,131	19,583	270,896
2019	Circuit2434	2,166	7,123	1,540	3,610	17,479	3,451	27,332	16,087
2019	Circuit2436	36,056	23,665	2,957	20,893	41,523	7,311	2,475	17,103
2019	Circuit2438	54	158,721	533	53,103	2,057	1,836	859	1,584
2019	Circuit2439	2,836	249,319	128,450	126,868	14,751	17,598	11,049	14,466
2019	Circuit3624		343		343		0	0	-
2019	Circuit2441	157			157	20	61	220	100
2019	Circuit2442	398,807	54,210	240,800	231,272	151,462	338,202	30,928	173,531
2019	Circuit2443	8,344	485,984	11,795	168,708	18,799	24,413	35,550	26,254
2019	Circuit2444	162,220	4,831	16,639	61,230	7,350	39,028	20,018	22,132
2019	Circuit2445	4,542	476	2,650	2,556	1,495	51,739	9,222	20,819
2019	Circuit2446	29,187	6,192	45,823	27,067	9,203	200,923	25,698	78,608
2019	Circuit2447	12,062	2,352	8,275	7,563	134,015	28,202	97,176	86,465
2019	Circuit2455	1,043	1,887	920	1,283	18,591	608	570	6,590
2019	Circuit2460	351	632	321	435	1,089	7,950	125,572	44,870
2019	Circuit2466		213		213	68	0	306	125
2019	Circuit2472	294	24,612	626	8,511	1,596	8,366	43,846	17,936
2019	Circuit2473	13,168	72,079	1,732	28,993	194,921	57,482	10,571	87,658
2019	Circuit2474	5,898	2,423	36,747	15,023	131,719	391	870	44,327
2019	Circuit1595		1,432		1,432		0	0	-

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1596		8,322	5,367	6,845	3,488	342	1,894	1,908
2019	Circuit1597	2,455	45,605	9,830	19,297	9,207	19,540	6,991	11,913
2019	Circuit1598	154,594	58,207	143,054	118,618	108,660	99,288	171,227	126,391
2019	Circuit1599	2,261	638,355	6,343	215,653	51,267	1,169	36,812	29,749
2019	Circuit1600	14,492	11,385	9,380	11,752	27,080	23,571	440,297	163,649
2019	Circuit1601	47,943	206,881	49,094	101,306	663,491	120,346	28,733	270,857
2019	Circuit1602	7,692	13,323	29,318	16,778	14,081	3,616	20,525	12,741
2019	Circuit1603	8,845	2,683	134,235	48,588	12,729	902	25,839	13,157
2019	Circuit1604	342,222	12,112	257,331	203,888	11,206	17,485	37,265	21,985
2019	Circuit1605	25,082	38,090	88,726	50,633	137,247	242,746	38,481	139,491
2019	Circuit1606	129,708	57,521	848,521	345,250	374,759	9,213	78,526	154,166
2019	Circuit1607	60,459	14,033	27,735	34,076	28,902	15,257	115,476	53,212
2019	Circuit3741		929		929		-	-	#DIV/0!
2019	Circuit2015		27,795	136	13,966	38,717	10,617	0	16,445
2019	Circuit2016	2,284	210,057	13,831	75,391	249,159	34,863	10,669	98,231
2019	Circuit2017	787	289,500	125,776	138,688	288,937	14,698	7,752	103,796
2019	Circuit2019	852	1,522	392	922	5,524	16,446	316	7,429
2019	Circuit2020		12,682	2,395	7,539	1,363	49,012	13,470	21,282
2019	Circuit2021	2,392			2,392		0	0	-
2019	Circuit2022	68,038	66,725	353,599	162,787	54,965	50,869	17,660	41,165
2019	Circuit2023	17,661	68,357	11,655	32,558	15,595	87,846	57,110	53,517
2019	Circuit2024	19,643	1,038,747	14,384	357,591	199,611	24,356	271	74,746
2019	Circuit2025	15,932	404,248	108,785	176,322	4,589	918,421	119,060	347,356
2019	Circuit3728	6,497			6,497		-	-	#DIV/0!
2019	Circuit1629	14,734	6,736	3,233	8,234	64,796	28,186	146,102	79,695
2019	Circuit1630	10,803	174,476	335,252	173,510	27,468	4,514	9,594	13,859
2019	Circuit1631	141,100	17,025	110,067	89,397	9,751	65,942	28,285	34,659
2019	Circuit1632	29,977	29,790	1,994	20,587	25,346	42,063	46,626	38,012
2019	Circuit1633	173,964	228,409	21,096	141,156	14,771	56,750	36,341	35,954
2019	Circuit2559	1,488	8,867	315,296	108,550	25,822	12,811	19,369	19,334
2019	Circuit1634	117,740	3,998	71,901	64,546	45,383	11,762	33,189	30,111
2019	Circuit2566	51,271	40,679	103,998	65,316	52,338	14,039	89,435	51,937
2019	Circuit2578	43,315	235,244	98,513	125,691	123,261	16,517	27,720	55,832
2019	Circuit2579	28,695	31,431	31,349	30,492	50,728	128,875	19,749	66,450
2019	Circuit3730	123			123		-	-	#DIV/0!
2019	Circuit1237	21,830	881	16,952	13,221	33,516	5,591	57,987	32,365
2019	Circuit1238	234			234		0	0	-
2019	Circuit1239	3,545	5,429	3,844	4,273	18,330	20,051	2,875	13,752
2019	Circuit1240	61,972	23,184	20,619	35,258	3,059	49	6,175	3,094
2019	Circuit1242	90,252	14,122	6,472	36,949	17,416	1,178	168	6,254
2019	Circuit1243	78,155	41,841	55,499	58,498	36,951	2,116	10,448	16,505
2019	Circuit1244	160,218	3,713	11,204	58,378	2,063	8,382	364,134	124,860
2019	Circuit1245	5,932	8,821	2,664	5,806	4,560	22,986	3,344	10,297
2019	Circuit1246	5,265	51,883	11,354	22,834	23,151	3,860	2,404	9,805

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3710				#DIV/0!		-	-	#DIV/0!
2019	Circuit820		6,036	5,265	5,651	2,233	0	2,513	1,582
2019	Circuit825		2,505	589	1,547		312	345	329
2019	Circuit826	14,847	37,109	2,363	18,106	2,428	1,448	3,542	2,473
2019	Circuit827	351	18,855	8,228	9,145	12,420	381	4,160	5,654
2019	Circuit828	334,753	542,526	1,191,746	689,675	702,809	242,002	37,476	327,429
2019	Circuit829	45,160	1,318,522	377,533	580,405	345,395	20,294	50,104	138,598
2019	Circuit830	132,143	393,347	89,117	204,869	145,515	40,690	178,032	121,412
2019	Circuit831	84	6,936	32,690	13,237	5,570	36	1,310	2,305
2019	Circuit832	216,834	404,062	80,006	233,634	437,587	67,955	87,101	197,548
2019	Circuit833	73,511	204,005	26,215	101,244	132,229	3,125	42,216	59,190
2019	Circuit834	6,055	169,569	80,889	85,504	68,653	175,589	22,593	88,945
2019	Circuit835	18,388	1,258,652	380,800	552,613	9,239	111,015	438,069	186,108
2019	Circuit836	23,261	275,382	208,497	169,047	64,724	17,459	46,593	42,926
2019	Circuit837	1,408	82,845	8,533	30,929	270	15,721	27,793	14,595
2019	Circuit838	79,153	588,199	589,672	419,008	351,731	41,103	110,992	167,942
2019	Circuit3578	8,385	96,091		52,238		0	0	-
2019	Circuit2679				#DIV/0!	24	7,411	10,106	5,847
2019	Circuit2681				#DIV/0!	18,882	20,381	263,580	100,947
2019	Circuit3736		267,120		267,120		-	-	#DIV/0!
2019	Circuit3733	20			20		-	-	#DIV/0!
2019	Circuit1663	95,261	1,179	469,228	188,556	29,509	311,700	1,805	114,338
2019	Circuit1664	42,492	105,586	20,817	56,298	21,514	37,188	7,239	21,980
2019	Circuit1665	74,032	26,885	146,930	82,616	112,293	79,917	39,208	77,139
2019	Circuit1666	695,916	1,362,361	55,175	704,484	269,642	174,426	36,256	160,108
2019	Circuit1668	11,183	222,204	21,935	85,107	2,786	133,391	16,564	50,913
2019	Circuit1669	115,467	14,759	29,647	53,291	346,026	142,552	120,055	202,877
2019	Circuit852	418	22,170	2,126	8,238	52,569	4,605	10,392	22,522
2019	Circuit853	5,987	123,104	17,116	48,736	4,459	6,086	6,971	5,839
2019	Circuit854	20,375	392,422	103,629	172,142	134,250	138,140	307,216	193,202
2019	Circuit856		2,095		2,095		0	0	-
2019	Circuit858	6,360	45,874	1,903	18,046	2,107	0	8,492	3,533
2019	Circuit859	127,430	83,303	196,457	135,730	14,073	25,867	142,968	60,969
2019	Circuit3743		91		91		-	-	#DIV/0!
2019	Circuit861	54,060	69,016	269,883	130,986	98,905	6,192	23,435	42,844
2019	Circuit862	128,755	19,651	42,052	63,486	3,032	28,744	146,706	59,494
2019	Circuit863	10,730	749,753	93,366	284,616	104,123	126,145	241,484	157,251
2019	Circuit864	1,322	2,131	4,771	2,741	637	3,789	23,364	9,263
2019	Circuit3742		6		6		-	-	#DIV/0!
2019	Circuit3739		121		121		-	-	#DIV/0!
2019	Circuit3711				#DIV/0!		-	-	#DIV/0!
2019	Circuit1684	5,682	2,037	12,117	6,612	4,960	7,344	1,435	4,580
2019	Circuit1685	1,225	63,422	23,891	29,513	7,745	68,645	1,505	25,965
2019	Circuit1686	32,790	12,223	6,101	17,038	7,926	9,243	15,088	10,752

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Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1687	8,974	3,241	7,316	6,510	6,340	63,352	3,286	24,326
2019	Circuit1688	72,270	10,176	34,309	38,918	181,456	6,860	4,468	64,261
2019	Circuit2729		239		239	204	0	72	92
2019	Circuit2730				#DIV/0!	1,714	0	0	571
2019	Circuit2732			489	489	859	0	337	398
2019	Circuit2733	275		19,456	9,866	11	55,630	120	18,587
2019	Circuit2734	146,997	2,267	132,305	93,856	2,555	64,618	13,114	26,762
2019	Circuit2737	16,923	30,205	55,665	34,264	22,625	2,512	23,127	16,088
2019	Circuit2738	1,542	2,035	28,511	10,696	17,083	19,492	7,517	14,697
2019	Circuit2739	34,103	70,225	27,903	44,077	12,668	25,047	739,770	259,162
2019	Circuit2740	16,730	127,593	54,693	66,339	12,773	14,578	12,069	13,140
2019	Circuit2741	5,825	71,435	127,150	68,137	75,184	175,689	462,767	237,880
2019	Circuit2742	12,486	327,232	731,659	357,126	780,120	16,825	665,190	487,378
2019	Circuit2744	4,858	26,434	41,690	24,327	17,129	132,709	52,335	67,391
2019	Circuit2745	5,485	11,598	18,572	11,885	4,753	9,104	12,689	8,849
2019	Circuit2746	40,677	30,537	310,364	127,193	24,400	103,286	37,114	54,933
2019	Circuit2752	14,507	12,134	17,648	14,763	51,446	22,429	231,106	101,660
2019	Circuit2753	9,454	1,969	14,592	8,672	4,584	20,692	3,164	9,480
2019	Circuit2754	11,646	132,008	17,630	53,761	35,690	9,645	6,948	17,428
2019	Circuit2755	2,884	6,244	9,136	6,088	7,721	10,021	1,222	6,321
2019	Circuit2756	678	30,509	101,084	44,090	11,434	1,377	8,774	7,195
2019	Circuit4087	1,346			1,346		-	-	#DIV/0!
2019	Circuit875	51,811	69,591	228,829	116,744	202,544	184,072	206,093	197,570
2019	Circuit876	193,797	41,805	17,666	84,423	711,619	136,145	37,822	295,195
2019	Circuit3712				#DIV/0!		-	-	#DIV/0!
2019	Circuit3716		49		49		-	-	#DIV/0!
2019	Circuit3587	124,352	84,528	183,614	130,831	958	0	0	319
2019	Circuit1701	274,894	1,463,010	96,202	611,369		0	0	-
2019	Circuit3588	25,968	52,790	35,930	38,229		0	0	-
2019	Circuit2060	447,266	19,726	625,184	364,059	26,165	2,143	18,412	15,574
2019	Circuit4088		20		20		-	-	#DIV/0!
2019	Circuit2790	5,786	452,834	32,782	163,801	34,269	44,661	128,054	68,995
2019	Circuit2791	84,444	74,607	36,152	65,068	49,212	62,520	67,137	59,623
2019	Circuit2792	40,671	220,223	126,061	128,985	250,461	63,977	65,118	126,519
2019	Circuit2794	46,448	195,975	137,137	126,520	74,124	34,035	114,137	74,099
2019	Circuit2807	42,503	3,536	71,248	39,096	48,885	315	3,074	17,424
2019	Circuit2808	5,170	10,671	5,332	7,058	31,270	7,180	30,252	22,900
2019	Circuit879	281		335	308	676	3,364	280	1,440
2019	Circuit880	717			717		7	0	4
2019	Circuit882	805	762	1,597	1,055		0	4,730	2,365
2019	Circuit883			210	210	652	0	16,836	5,829
2019	Circuit884	295	1,742		1,019		147	1,162	655
2019	Circuit886	309	41,425	1,780	14,505	1,304	0	1,164	823
2019	Circuit887	5,100	9,656	112,694	42,483	290,752	6,146	30,283	109,060

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Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit888	15,426	299,537	144	105,036	23,895	104,670	11,901	46,822
2019	Circuit889	211,368	141,062	137,132	163,187	142,525	107,798	89,132	113,152
2019	Circuit892	3,557	172,265	71,392	82,405	140,600	485,612	17,179	214,464
2019	Circuit893	67,339	62,181	3,621	44,380	6,900	2,475	7,733	5,702
2019	Circuit2063	92,881	111,718	40,678	81,759	262,152	16,642	54,232	111,009
2019	Circuit3718				#DIV/0!		-	-	#DIV/0!
2019	Circuit2067		8,149	15,085	11,617	2,619	972	1,897	1,830
2019	Circuit2068	81,559	134,656	93,237	103,151	65,873	170,544	37,149	91,188
2019	Circuit2069	7,858	6,496	488,520	167,625	51,005	178,683	20,891	83,526
2019	Circuit2070	10,656	108,084	52,976	57,239	92,479	42,225	214,924	116,543
2019	Circuit2071	14,698	39,092	64,458	39,416	156,723	27,150	7,913	63,929
2019	Circuit2072	6,932	20,297	102,783	43,337	24,555	2,532	6,122	11,070
2019	Circuit3740		874		874		-	-	#DIV/0!
2019	Circuit895		153		153	1,172	50	0	407
2019	Circuit3622				#DIV/0!		-	-	#DIV/0!
2019	Circuit3643				#DIV/0!		1,103	0	551
2019	Circuit896				#DIV/0!	296	0	0	99
2019	Circuit3623	15,140	21,726		18,433		-	-	#DIV/0!
2019	Circuit897	2,460	3,964	21,473	9,299	1,886	0	84	656
2019	Circuit901	431	20,298	7,448	9,392	39	25,006	4,413	9,819
2019	Circuit903	6,843	8,730	10,181	8,585	60,980	8,684	6,340	25,335
2019	Circuit904	228,979	14,791	64,614	102,795	27,858	79,048	127,828	78,245
2019	Circuit3734	3,975	1,600		2,788		-	-	#DIV/0!
2019	Circuit1708	323,776	31,131	10,658	121,855	44,945	6,956	139,211	63,704
2019	Circuit1709	40,636	6,452	3,349	16,812	1,769	25,242	72,460	33,157
2019	Circuit1712	39,729	138,401	22,662	66,931	914	7,408	3,666	3,996
2019	Circuit2083	44,088	126,936	12,758	61,261	88,528	3,611	24,310	38,817
2019	Circuit2084	154,498	7,339	1,055	54,297	471,825	121,413	2,460	198,566
2019	Circuit2085	306,927	17,346	239,138	187,804	123,318	11,714	8,092	47,708
2019	Circuit2086	12,769	2,418		7,594		0	0	-
2019	Circuit3731	1,660			1,660		-	-	#DIV/0!
2019	Circuit2087	10,498	12,919	10,803	11,407	116,142	172,023	42,232	110,132
2019	Circuit2088	356,516	254,698	285,158	298,791	189,366	438,389	6,565	211,440
2019	Circuit1717	1,035	240	422	566		0	376	188
2019	Circuit1719				#DIV/0!		0	580	290
2019	Circuit1721			177	177		0	0	-
2019	Circuit1727	5,004	385		2,695	5,165	25	0	1,730
2019	Circuit1728	1,566	15,260	1,518	6,115	1,191	14,484	5,350	7,008
2019	Circuit1729	385		5,066	2,726	23	157	111	97
2019	Circuit1730	502	1,696		1,099	396	917	224	512
2019	Circuit1732	226,768	188,790	4,779	140,112	59,083	38,653	85,305	61,014
2019	Circuit1733	272,605	83,239	46,843	134,229	115,344	23,807	11,267	50,139
2019	Circuit1734	140,223	188,095	1,270,146	532,821	657,575	16,511	11,928	228,671
2019	Circuit1735	157,642	120,968	855,623	378,078	39,220	5,492	67,614	37,442

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2019	Circuit1736	18,510	137,713	77,334	77,852	93,298	31,549	90,034	71,627
2019	Circuit1737	18,853	72,956	227,295	106,368	11,990	105,976	11,967	43,311
2019	Circuit1738	64,808	48,274	1,027,214	380,099	46,518	134,927	32,111	71,185
2019	Circuit1739	10,054	35,422	484,305	176,594	17,001	23,432	31,967	24,133
2019	Circuit2859	494,474	33,109	75,396	200,993	5,699	2,837	9,606	6,047
2019	Circuit1401	3,699	44,831	9,268	19,266	52,709	27,668	1,757	27,378
2019	Circuit1402	60,907	119,449	678,409	286,255	78,355	142,570	8,515	76,480
2019	Circuit3738		35		35		-	-	#DIV/0!
2019	Circuit2862		3,869		3,869	247	6,814	13	2,358
2019	Circuit2863	433	9,171	112	3,239	711	880	12,187	4,592
2019	Circuit2864	49,580	1,457	33,465	28,167	897	17,259	6,461	8,206
2019	Circuit2865	21,642	3,871	62,462	29,325	174,790	19,713	12,912	69,139
2019	Circuit2866	97,021	42,556	11,287	50,288	65,403	135,876	25,541	75,607
2019	Circuit2869	53,049	102,923	18,097	58,023	7,948	17,578	29,659	18,395
2019	Circuit2870	220,306	74,235	50,386	114,976	136,723	109,511	39,160	95,131
2019	Circuit2877	8,315	217,461	45,516	90,431	104,524	132,659	26,822	88,002
2019	Circuit2878		166,383		166,383		0	0	-
2019	Circuit2879	76,126	24,531	2,821	34,493	56,680	10,792	30,455	32,642
2019	Circuit2881	83,159	67,906	93,521	81,529	104,444	11,854	68,441	61,579
2019	Circuit2882	53,604	7,029	38,576	33,070	19,090	2,087	4,623	8,600
2019	Circuit2884	305,297	822	16,086	107,402	61,369	4,681	52,555	39,535
2019	Circuit2885	11,356	27,613	75,342	38,104	112,551	113,762	157,081	127,798
2019	Circuit2886	55,873	141,972	30,318	76,054	13,925	8,352	5,482	9,253
2019	Circuit2887	7,729	67,538	70,980	48,749	164,364	10,281	1,088,576	421,074
2019	Circuit2888	3,507	4,805	6,498	4,937	214,979	11,081	531	75,530
2019	Circuit2889	114,030	3,977	3,402	40,470	17,776	94,278	96,265	69,440
2019	Circuit2890	55,771	12,780	20,743	29,765	9,653	3,678	114,602	42,644
2019	Circuit2895	10,412	3,695	82,825	32,311	13,241	51,338	1,867	22,149
2019	Circuit3727	186			186		-	-	#DIV/0!
2019	Circuit3719				#DIV/0!		-	-	#DIV/0!
2019	Circuit3590		1,010	3,823	2,417	0	0	0	-
2019	Circuit3591	5,017	1,240	4,871	3,709	0	0	0	-
2019	Circuit3592	239,619	31,402	118,114	129,712	0	0	0	-
2019	Circuit3594	95,172	1,422		48,297	0	0	0	-
2019	Circuit3595	175,405	79,752	215,030	156,729	0	0	0	-
2019	Circuit1752	4,420	9,828	4,622	6,290	2,734	20,024	38,805	20,521
2019	Circuit1753	8,081	14,270	1,277	7,876	15,777	16,253	69,724	33,918
2019	Circuit1759	129,070	10,534	1,703	47,102	98,558	34,793	99,721	77,691
2019	Circuit1754	7,186	189,954	13,666	70,269	46,573	210,477	59,897	105,649
2019	Circuit1755	274	85,962	13,945	33,394	3,523	7,607	89,485	33,539
2019	Circuit1756	9,632	6,733	76,386	30,917	8,578	83,046	193,448	95,024
2019	Circuit2932	6,040	53,132	121,347	60,173	33,215	84,307	32,893	50,138
2019	Circuit2933	316,395	474,141	26,664	272,400	96,472	24,338	15,129	45,313
2019	Circuit2934	38,139	33,351	19,753	30,414	54,465	62,414	35,371	50,750

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit2935	36,366	17,166	82,743	45,425	89,080	221,679	83,044	131,268
2019	Circuit2936	3,250	2,350	22,183	9,261	22,863	15,525	6,186	14,858
2019	Circuit2937	1,102	3,572	180,136	61,603	47,943	31,221	23,843	34,336
2019	Circuit1250	5,728	995	1,349	2,691	197	1,041	2,306	1,181
2019	Circuit1252	5,723	17,288	5,772	9,594	21,594	2,757	122,450	48,934
2019	Circuit1253	50,914	55,892	32,227	46,344	50,770	38,779	43,390	44,313
2019	Circuit1255	2,540	19,222	15,066	12,276	5,023	500,305	251,465	252,264
2019	Circuit1256	16,892	449,523	74,838	180,418	16,022	320,897	299,470	212,130
2019	Circuit1257	7,896		4,097	5,997	7,268	107	8,487	5,287
2019	Circuit944	95,625	3,826	4,115	34,522	102,324	175,584	34,199	104,036
2019	Circuit945			11	11	127	596	0	241
2019	Circuit946	63,600	7,878	1,965	24,481	26,845	25,582	107,797	53,408
2019	Circuit947	15,089	105	4,958	6,717	19,808	81,175	1,439	34,141
2019	Circuit3649			114	114		0	0	-
2019	Circuit1766	365,306	205,468	25,981	198,918	3,667	3,688	42,941	16,765
2019	Circuit1768	47,109	763	3,389	17,087	32,654	44,713	46,293	41,220
2019	Circuit1769	277,425	2,070	1,439	93,645	454	417,183	339,655	252,431
2019	Circuit1771				#DIV/0!		0	0	-
2019	Circuit1772	247,664	7,746	70,474	108,628	5,156	81,784	9,013	31,984
2019	Circuit1773	4,223	307,020	202,117	171,120	70,329	66,725	14,163	50,406
2019	Circuit1774	17,029	241,928	92,979	117,312	27,716	17,805	940	15,487
2019	Circuit948	227			227		0	0	-
2019	Circuit950	34,133	170,298	4,775	69,735	4,916	37,456	5,251	15,874
2019	Circuit951	98,358	30,797	41,377	56,844	195,131	32,994	24,251	84,126
2019	Circuit952	38,433	243,841	411,900	231,391	17,187	22,674	37,318	25,726
2019	Circuit953	80,420	102,413	176,332	119,722	25,483	30,493	30,681	28,886
2019	Circuit954	107,716	445,752	141,600	231,689	80,620	149,621	10,084	80,109
2019	Circuit955	90,588	55,752	197,330	114,557	103,331	137,568	122,401	121,100
2019	Circuit4089				#DIV/0!		-	-	#DIV/0!
2019	Circuit2993		1,059	405	732	696	0	656	451
2019	Circuit2994	38,770	5,059		21,915	5,670	8,164	2,342	5,392
2019	Circuit2995	685,006	180,019	18,388	294,471	8,073	25,043	79,932	37,683
2019	Circuit2996	551,338	54,195	27,672	211,068	43,419	42,185	12,248	32,617
2019	Circuit2997	382,104	80,730	21,577	161,470	9,597	618,216	13,936	213,916
2019	Circuit2998	867,919	66,080	182,010	372,003	52,182	53,097	189,016	98,098
2019	Circuit2999	573,451	100,081	349,603	341,045	110,083	48,411	13,590	57,361
2019	Circuit3737		899		899		-	-	#DIV/0!
2019	Circuit3598	400			400		0	0	-
2019	Circuit3041	5,343	552	71,330	25,742	4,016	219,164	116,239	113,140
2019	Circuit3056	1,336	3,610	24,203	9,716	318	1,184	3,563	1,688
2019	Circuit3064	76,592	29,719	32,087	46,133	5,614	26,237	91,967	41,273
2019	Circuit3065	219,910	130,562	102,055	150,842	154,521	180,263	135,640	156,808
2019	Circuit3066	13,002	159,231	495,143	222,459	35,480	128,841	51,495	71,939
2019	Circuit3069			194	194	190	21	0	70

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4.8kV Hardening Data

		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1779	209,404	284,341	105,110	199,618	43,413	64,182	2,745	36,780
2019	Circuit3070	7,736	80,375	138,607	75,573	27,408	36,373	8,344	24,042
2019	Circuit3071	195,833	5,050	10,576	70,486	449,629	7,914	4,276	153,940
2019	Circuit3072	4,278	20,023	5,748	10,016	53,203	3,569	23,262	26,678
2019	Circuit3073	318,760	79,099	67,422	155,094	2,173	341,806	202,960	182,313
2019	Circuit3074	770	8,227	552,922	187,306	2,490	9,554	9,042	7,029
2019	Circuit1780	21,561	16,500	347	12,803	126,714	292,914	20,393	146,674
2019	Circuit1782			854	854	141	6,130	2,999	3,090
2019	Circuit1783			2,103	2,103	1,970	3,280	2,896	2,716
2019	Circuit1785	1,141	2,743	300	1,395	345	26,187	3,323	9,952
2019	Circuit1788	17,185			17,185	727	1,307	2,606	1,547
2019	Circuit1789	70,074	34,681	217,953	107,569	107,132	119,051	50,414	92,199
2019	Circuit1790	124,226	83,879	294,168	167,424	1,771	209,474	16,072	75,772
2019	Circuit1791	3,536	5,189	342,461	117,062	49,973	19,894	312,465	127,444
2019	Circuit1792	36,366	293,704	55,984	128,685	269,391	176,374	40,027	161,931
2019	Circuit1793	8,571	8,605	12,163	9,780	33,803	642,448	411,683	362,645
2019	Circuit1794	168,137	110,523	407,096	228,585	306,508	217,192	165,535	229,745
2019	Circuit1795	872		3,391	2,132	974	17,452	290,082	102,836
2019	Circuit3657	11,768	444		6,106		0	0	-
2019	Circuit3606	1,247	135	1,322	901		0	0	-
2019	Circuit3607	1,511			1,511		0	0	-
2019	Circuit3608	471		89	280	476	0	0	159
2019	Circuit3609			113	113	6	0	3,197	1,067
2019	Circuit3660				#DIV/0!		0	0	-
2019	Circuit3713				#DIV/0!		-	-	#DIV/0!
2019	Circuit3662				#DIV/0!	99	0	0	33
2019	Circuit3663	312	1,404		858		0	0	-
2019	Circuit3611	116,235	26,520	13,145	51,967	1,022	58	9	363
2019	Circuit3714	923,739			923,739		-	-	#DIV/0!
2019	Circuit3096	66,825			66,825	2,004	10,724	647	4,458
2019	Circuit3097	232,289	66,891	8,701	102,627	261,453	295,977	267,737	275,056
2019	Circuit3099	218,855	33,917	5,918	86,230	303,144	99,920	137,167	180,077
2019	Circuit3100	17,506	46,026	43,507	35,680	74,989	215,421	145,133	145,181
2019	Circuit3101	44,746	819,270	178,942	347,653	373,769	225,064	26,597	208,477
2019	Circuit3102	20,280	13,534	20,495	18,103	168,493	1,278	49,450	73,074
2019	Circuit1798	77,736	199,974	52,181	109,964	78,156	197,061	46,895	107,371
2019	Circuit1799	35,812	158,577	102,844	99,078	162,856	41,294	91,890	98,680
2019	Circuit1800	24,022	25,490	107,222	52,245	37,109	303,011	19,633	119,918
2019	Circuit1801	12,552	294,939	112,263	139,918	32,333	48,969	44,625	41,976
2019	Circuit1802	77,097	104,802	66,631	82,843	192,855	12,404	13,763	73,007
2019	Circuit1803	297	2,468		1,383	190	2,719	2,389	1,766
2019	Circuit1804	12,912	61,786	61,698	45,465	17,220	90,846	112,637	73,568
2019	Circuit1805				#DIV/0!		0	0	-
2019	Circuit3124	7,121		239	3,680	3,709	1,569	1,113	2,130

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3126	282	13,860	1,574	5,239	258	0	75	111
2019	Circuit3131	87,375	37,719	55,966	60,353	28,919	130,378	40,839	66,712
2019	Circuit4090		258		258		-	-	#DIV/0!
2019	Circuit1812	177	940	2,326	1,148	1,063	11,793	28,238	13,698
2019	Circuit1815		2,363	7,123	4,743	1,285	254	0	513
2019	Circuit1816				#DIV/0!	230	0	429	219
2019	Circuit1817				#DIV/0!	6	195	553	251
2019	Circuit1818	821	1,138	399	786		0	275	138
2019	Circuit1819	10,962	2,034	970	4,655	3,740	3,549	265	2,518
2019	Circuit1820	27,823	96,511	7,680	44,005	51,376	35,201	16,976	34,517
2019	Circuit1821	3,465	545,129	1,252,964	600,519	420,795	1,012	8,884	143,563
2019	Circuit1822	20,852	6,227	1,765	9,615	3,347	2,711	1,078	2,378
2019	Circuit1823	146,297	3,275	274,819	141,464	475,360	50,183	7,071	177,538
2019	Circuit1824	1,191,924	31,758	53,183	425,622	368,741	139,004	232,985	246,910
2019	Circuit1825	501,917	484,533	143,830	376,760	64,831	60,928	86,838	70,866
2019	Circuit1826	363,101	74	76,112	146,429	10,115	11,727	308	7,384
2019	Circuit3156				#DIV/0!	94	0	0	31
2019	Circuit1827	1,922	145	2,091	1,386	141,148	336,707	5,367	161,074
2019	Circuit1828	57,237	55,710	284,793	132,580	73,661	10,636	1,659	28,652
2019	Circuit1829	38,770	1,816	58,252	32,946	120,507	3,369	138,478	87,451
2019	Circuit1830	25,287	66,772	15,212	35,757	9,581	316,067	25,640	117,096
2019	Circuit3184	1,834	3,232	192	1,753	1,300	278	211	596
2019	Circuit3185	100	6,067	277,052	94,406	427,659	25,922	204,110	219,230
2019	Circuit3186	1,945	5,449	156,751	54,715	398,038	10,601	49,214	152,618
2019	Circuit3187	123,930	323,628	13,805	153,788	25,653	66,570	31,036	41,086
2019	Circuit3188	3,702	4,521	54,018	20,747	46,047	119,737	67,049	77,611
2019	Circuit3189	563,655	84		281,870		0	0	-
2019	Circuit3190	123,207	4,687	7,100	44,998	1,715	30,025	20,139	17,293
2019	Circuit3192	18,036	27,373	187,697	77,702	289,371	26,318	111,442	142,377
2019	Circuit3193	7,950	22,547	80,396	36,964	183,217	72,681	20,318	92,072
2019	Circuit3194	81,539	35,026	125,618	80,728	89,743	13,820	91,696	65,086
2019	Circuit3195	21,877	89,391	48,712	53,327	172,837	66,143	323,991	187,657
2019	Circuit1839	20,279	10,832	24,506	18,539	30,336	1,028,010	5,326	354,558
2019	Circuit1845	33,153	172,234	13,554	72,980	10,181	44,679	3,516	19,458
2019	Circuit1846	22,925	30,568	95,867	49,787	48,896	11,641	4,341	21,626
2019	Circuit1847	-	6,652		3,326	70,539	9,538	88,459	56,178
2019	Circuit1848	3,412	85,053	119,072	69,179	56,317	96,078	1,554	51,316
2019	Circuit1849	11,491	117,264	55,119	61,291	6,356	2,229	67,284	25,290
2019	Circuit1850		38	1,011	525	20	252	0	90
2019	Circuit1851	11,052	207,170	114,556	110,926	215,969	30,151	28,080	91,400
2019	Circuit1852	1,666	9,393	19,096	10,052	54	17	7	26
2019	Circuit1853	2,374	848	1,910	1,711	1,509	11,163	5,307	5,993
2019	Circuit1854	123,831	12,338	42,258	59,476	12,772	39,600	48,892	33,755
2019	Circuit1433	16,202	120,316	67,077	67,865	14,412	63,634	128,471	68,839

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1434	19,076	158,325	122,157	99,853	29,368	148,126	270,516	149,337
2019	Circuit2145	15,696	3,295	10,997	9,996	26,536	205,633	883	77,684
2019	Circuit2146	56,363	569,031	55,681	227,025	22,444	344,968	29,363	132,258
2019	Circuit2147	21,156	21,510	5,526	16,064	3,655	711,638	3,838	239,710
2019	Circuit4091				#DIV/0!		-	-	#DIV/0!
2019	Circuit1298	4,696	8,920	65,625	26,414	134,689	22,631	11,578	56,299
2019	Circuit3717				#DIV/0!		-	-	#DIV/0!
2019	Circuit3735		1,903		1,903		-	-	#DIV/0!
2019	Circuit3677	158			158		0	0	-
2019	Circuit1878	19,192	35,834	215,143	90,056	42,949	19,217	20,342	27,503
2019	Circuit1879			19	19	5,105	814	1,590	2,503
2019	Circuit1880	28,863	1,966	7,014	12,614	9,259	742,999	211,734	321,331
2019	Circuit2150	717,133	282,320	448,483	482,645	133,497	63,745	290,330	162,524
2019	Circuit3721				#DIV/0!		-	-	#DIV/0!
2019	Circuit3314	6,832		2,011	4,422	10	0	0	3
2019	Circuit3316	1,698	4,195	27,234	11,042	2,897	7,684	1,482	4,021
2019	Circuit3317	19,128	3,892	4,927	9,316	3,271	2,029	65,134	23,478
2019	Circuit3318	53,779	9,077	5,640	22,832	345	1,096	1,593	1,011
2019	Circuit3319	85,187	1,553	4,739	30,493	7,749	1,773	10,130	6,551
2019	Circuit3320	4,088	28,698	13,399	15,395	12,555	36,285	19,276	22,705
2019	Circuit3321	19,836	2,138	3,659	8,544	20,517	37,206	22,922	26,882
2019	Circuit3322	4,096	923	1,606	2,208	1,240	6,369	251	2,620
2019	Circuit3323	1,836	8,354	214	3,468	113,598	13,428	1,550	42,859
2019	Circuit3324	4,385	2,315	1,460	2,720	27,883	5,273	12,633	15,263
2019	Circuit2167	12,195	22,235	41,003	25,144	1,105	6,701	168,748	58,851
2019	Circuit2165	114,146	13,493	157,420	95,020	113,364	4,041	1,057	39,487
2019	Circuit2166	31,922	18,593	107,666	52,727	2,621	8,687	2,901	4,736
2019	Circuit3395	42,234	78,591	753,459	291,428	126,709	68,298	42,522	79,176
2019	Circuit3397	1,007	14,561	3,918	6,495	21,895	25,299	27,957	25,050
2019	Circuit3398	5,794	100,476	2,904	36,391	32,121	17,745	6,042	18,636
2019	Circuit3399				#DIV/0!	20	1,218	126	455
2019	Circuit3400	213,309	226,102	60,676	166,696	238,156	32,630	132,646	134,477
2019	Circuit3724				#DIV/0!		-	-	#DIV/0!
2019	Circuit1907	592			592	112	170	5,882	2,055
2019	Circuit1908	977		1,097	1,037	15,728	0	193,805	69,844
2019	Circuit1910	9,572	7,876	6,454	7,967	156,383	9,298	939,971	368,550
2019	Circuit1912	85,637	47,989	55,801	63,142	154,392	29,390	2,579,440	921,074
2019	Circuit1926	14,123	3,698	1,518	6,446	4,672	4,789	28	3,163
2019	Circuit1009	107	2,997	4,313	2,472	19,633	79,566	8,868	36,022
2019	Circuit1010	17,505	159,215	43,819	73,513	85,152	74,586	36,299	65,346
2019	Circuit1011	3,147	3,886	18,854	8,629	6,280	26,636	1,006	11,307
2019	Circuit1012	886	26,691	3,905	10,494	43,139	104,738	4,279	50,719
2019	Circuit1013	3,762	214,338	106,882	108,327	28,005	176,636	12,046	72,229
2019	Circuit1014	1,820	6,192	186,124	64,712	6,911	80,005	52,549	46,488

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit1016	102,648	730,789	74,244	302,560	169,444	292,952	86,939	183,112
2019	Circuit1017	6,563	173,025	3,822	61,137	198,867	746,022	53,480	332,790
2019	Circuit1018	1,771	3,095	5,129	3,332	85,242	6,843	692	30,926
2019	Circuit1019	6,090	248,968	81,424	112,161	30,435	9,823	21,582	20,614
2019	Circuit1022	20,240	521,134	277,424	272,933	177,399	36,031	9,902	74,444
2019	Circuit1023	593	19,478	54,082	24,718	4,729	55,078	10,890	23,566
2019	Circuit3732	11,020			11,020		-	-	#DIV/0!
2019	Circuit1936	249	1,004	355	536		1,439	121	780
2019	Circuit1938	339			339		55	821	438
2019	Circuit1939	19,018	135,111	367,254	173,794	32,131	45,258	25,629	34,339
2019	Circuit1940	206,285	1,230,705	649,654	695,548	81,937	72,084	58,039	70,687
2019	Circuit1941	104,966	36,074	585,589	242,210	846,397	185,851	16,439	349,562
2019	Circuit1024	6,855	29,538	5,260	13,884	2,679	617	8,343	3,879
2019	Circuit1026	101	1,488	63,181	21,590	706	53,921	7	18,211
2019	Circuit1028	1,110	3,286	1,648	2,015	192	19,817	0	6,670
2019	Circuit1029	2,448	378		1,413	2,560	2,682	12	1,752
2019	Circuit1030	356		2,410	1,383	9	97,352	111	32,491
2019	Circuit1031				#DIV/0!		91	0	45
2019	Circuit1032	1,303	139		721	16,023	64	6,482	7,523
2019	Circuit1033	141	1,286	1,333	920		333	0	166
2019	Circuit1034		758	46	402		693	517	605
2019	Circuit3725				#DIV/0!		-	-	#DIV/0!
2019	Circuit3726				#DIV/0!		-	-	#DIV/0!
2019	Circuit1037	1,445	38		742		0	0	-
2019	Circuit3729	163,712	7,222		85,467		-	-	#DIV/0!
2019	Circuit3484	16,216	3,690	301	6,736	10,550	5,791	49,672	22,004
2019	Circuit3722	85			85		-	-	#DIV/0!
2019	Circuit3486	9,648	8,911	12,298	10,286		1,233	248	741
2019	Circuit3487	15,646	2,250	2,552	6,816	993	16,779	424	6,065
2019	Circuit3488	8,088	278	12,139	6,835	1,442	217	8,212	3,291
2019	Circuit3489			46,853	46,853	84,918	93,432	13,341	63,897
2019	Circuit3490	136,458	12,350	57,868	68,892	251,853	264,742	21,345	179,313
2019	Circuit3690	2,188	1,430		1,809		-	-	#DIV/0!
2019	Circuit3491	212,043	82,515	289,375	194,644	91,941	55,544	20,260	55,915
2019	Circuit3492	105,307	78,996	6,442	63,582	8,604	16,614	1,099	8,772
2019	Circuit3493	181,353	28,699	94,013	101,355	404,909	41,766	29,997	158,891
2019	Circuit3495	4,233	18,435	19,038	13,902	138,745	6,243	75,765	73,584
2019	Circuit3496	93,563	941	4,577	33,027	5,551	381,925	601,913	329,796
2019	Circuit3497	16,639	117,362	45,951	59,984	39,300	192,853	140,604	124,253
2019	Circuit3498	23,200	70,347	8,623	34,057	432,169	6,396	96,953	178,506
2019	Circuit3499	32,986	12,554	128,667	58,069	16,498	26,474	155,716	66,229
2019	Circuit3501	18,824	225,442	66,117	103,461	117,261	237,364	105,778	153,468
2019	Circuit3502	231,935	241,252	25,301	166,163	322,488	46,482	122,966	163,979
2019	Circuit3503	35,954	9,164	590,297	211,805	197,284	81,370	93,554	124,069

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	Circuit3509	1,663	246,345	6,980	84,996	15,392	132,108	6,989	51,496
2019	Circuit3510	106,981	45,369	11,764	54,705	48,477	21,818	71,479	47,258
2019	Circuit3511	37,565	3,950	16,024	19,180	126,833	293,423	13,283	144,513
2019	Circuit3513	272		61,103	30,688	439	4,661	8,842	4,647
2019	Circuit3723				#DIV/0!		-	-	#DIV/0!
2019	Circuit3535	718			718		0	0	-
2019	Circuit3686	9,602	257		4,930		0	0	-
2019	Circuit3536				#DIV/0!		205	594	399
2019	Circuit3537		4,531	24,703	14,617	409	1,284	6,743	2,812
2019	Circuit3688			10,293	10,293		0	0	-
2019	Circuit3619	14,439	35,599	203,412	84,483		0	0	-
2019	Circuit3621	43,055	463,431	9,406	171,964		0	0	-
2019	Circuit1047	9,144	3,885	511,937	174,989	21,661	18,829	25,900	22,130
2019	Circuit1048	41,898	40,805	26,265	36,323	64,831	21,434	24,195	36,820
2019	Circuit2376				#DIV/0!	142,408	20,515	41,636	68,186
2019	Circuit1049	13,226	138,395	20,154	57,258	86,949	12,063	7,544	35,519
2019	Circuit2377			120	120	558,743	131,167	51,389	247,100
2019	Circuit2378				#DIV/0!	92,579	87,503	22,943	67,675
2020	Circuit3715	103		-	52		-	-	#DIV/0!
2020	Circuit3720	52		-	26		-	-	#DIV/0!
2020	Circuit206	184,029	17,046	7,536	69,537	2,500	161,685	1,264	55,150
2020	Circuit208	47,375	664	2,020	16,686	12,249	791	8,796	7,279
2020	Circuit211	91,615	43,484	100,688	78,596	14,131	19,583	9,974	14,562
2020	Circuit2434	7,123	1,540	4,101	4,255	3,451	27,332	2,117	10,966
2020	Circuit2438	158,721	533	238	53,164	1,836	859	49,425	17,373
2020	Circuit2439	249,319	128,450	1,798	126,522	17,598	11,049	5,436	11,361
2020	Circuit3624	343		-	172		0	-	-
2020	Circuit2441			59	59	61	220	653	312
2020	Circuit2442	54,210	240,800	12,867	102,626	338,202	30,928	411,987	260,372
2020	Circuit2443	485,984	11,795	23,773	173,851	24,413	35,550	146,094	68,686
2020	Circuit2444	4,831	16,639	20,962	14,144	39,028	20,018	31,250	30,098
2020	Circuit2445	476	2,650	32,700	11,942	51,739	9,222	15,765	25,575
2020	Circuit2446	6,192	45,823	30,015	27,343	200,923	25,698	12,103	79,575
2020	Circuit2447	2,352	8,275	15,251	8,626	28,202	97,176	16,302	47,227
2020	Circuit2455	1,887	920	-	936	608	570	972	717
2020	Circuit2460	632	321	10,191	3,715	7,950	125,572	2,854	45,459
2020	Circuit2466	213		-	107		306	0	153
2020	Circuit2472	24,612	626	7,120	10,786	8,366	43,846	6,296	19,503
2020	Circuit2473	72,079	1,732	404,378	159,396	57,482	10,571	17,739	28,597
2020	Circuit2474	2,423	36,747	7,808	15,659	391	870	840	700
2020	Circuit1595	1,432		-	716		0	0	-
2020	Circuit3741	929		-	465		-	-	#DIV/0!
2020	Circuit2019	1,522	392	10,970	4,295	16,446	316	21,224	12,662
2020	Circuit2020	12,682	2,395	13	5,030	49,012	13,470	123,327	61,937

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2023	68,357	11,655	156,340	78,784	87,846	57,110	778,458	307,804
2020	Circuit2025	404,248	108,785	26,425	179,819	918,421	119,060	400,317	479,266
2020	Circuit3728			-	-		-	-	#DIV/0!
2020	Circuit1629	6,736	3,233	1,667	3,879	28,186	146,102	79,622	84,637
2020	Circuit1630	174,476	335,252	12,420	174,049	4,514	9,594	4,138	6,082
2020	Circuit1631	17,025	110,067	14,433	47,175	65,942	28,285	12,519	35,582
2020	Circuit1632	29,790	1,994	39,761	23,848	42,063	46,626	48,604	45,764
2020	Circuit1633	228,409	21,096	5,632	85,046	56,750	36,341	68,028	53,706
2020	Circuit2559	8,867	315,296	55,431	126,531	12,811	19,369	20,441	17,541
2020	Circuit1634	3,998	71,901	38,593	38,164	11,762	33,189	10,769	18,574
2020	Circuit2566	40,679	103,998	24,128	56,268	14,039	89,435	35,381	46,285
2020	Circuit2578	235,244	98,513	1,340,107	557,955	16,517	27,720	26,301	23,513
2020	Circuit2579	31,431	31,349	206,858	89,879	128,875	19,749	2,571	50,398
2020	Circuit3730			-	-		-	-	#DIV/0!
2020	Circuit1238			-	-		0	0	-
2020	Circuit1244	3,713	11,204	100,151	38,356	8,382	364,134	1,129	124,548
2020	Circuit1245	8,821	2,664	3,097	4,861	22,986	3,344	1,962	9,431
2020	Circuit1246	51,883	11,354	27,276	30,171	3,860	2,404	8,507	4,924
2020	Circuit3710			-	-		-	-	#DIV/0!
2020	Circuit828	542,526	1,191,746	559,205	764,492	242,002	37,476	109,417	129,632
2020	Circuit829	1,318,522	377,533	422,710	706,255	20,294	50,104	230,199	100,199
2020	Circuit830	393,347	89,117	515,086	332,517	40,690	178,032	18,460	79,061
2020	Circuit832	404,062	80,006	71,095	185,054	67,955	87,101	801,355	318,804
2020	Circuit835	1,258,652	380,800	39,728	559,727	111,015	438,069	70,358	206,481
2020	Circuit3578	96,091		-	48,046		0	-	-
2020	Circuit2679			-	-	7,411	10,106	2,810	6,776
2020	Circuit2681			115	115	20,381	263,580	94,075	126,012
2020	Circuit3736	267,120		-	133,560		-	-	#DIV/0!
2020	Circuit3733			-	-		-	-	#DIV/0!
2020	Circuit1663	1,179	469,228	25,936	165,448	311,700	1,805	2,288	105,264
2020	Circuit1664	105,586	20,817	4,779	43,727	37,188	7,239	13,386	19,271
2020	Circuit1665	26,885	146,930	2,340	58,718	79,917	39,208	15,598	44,908
2020	Circuit1666	1,362,361	55,175	12,751	476,762	174,426	36,256	18,984	76,555
2020	Circuit1668	222,204	21,935	4,485	82,875	133,391	16,564	5,602	51,852
2020	Circuit1669	14,759	29,647	4,355	16,254	142,552	120,055	23,791	95,466
2020	Circuit3743	91		-	46		-	-	#DIV/0!
2020	Circuit3742	6		-	3		-	-	#DIV/0!
2020	Circuit3739	121		-	61		-	-	#DIV/0!
2020	Circuit3711			-	-		-	-	#DIV/0!
2020	Circuit1684	2,037	12,117	1,476	5,210	7,344	1,435	41,835	16,871
2020	Circuit1685	63,422	23,891	2,572	29,962	68,645	1,505	31,795	33,982
2020	Circuit1686	12,223	6,101	1,934	6,753	9,243	15,088	80,256	34,862
2020	Circuit1687	3,241	7,316	5,950	5,502	63,352	3,286	14,425	27,021
2020	Circuit1688	10,176	34,309	27,151	23,879	6,860	4,468	11,939	7,756

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2729	239		20	130		72	0	36
2020	Circuit2730			-	-		0	0	-
2020	Circuit2732		489	-	245		337	0	168
2020	Circuit2733		19,456	17	9,737	55,630	120	23,883	26,544
2020	Circuit2734	2,267	132,305	1,149	45,240	64,618	13,114	25,793	34,508
2020	Circuit2737	30,205	55,665	17,835	34,568	2,512	23,127	131,014	52,217
2020	Circuit2738	2,035	28,511	13,419	14,655	19,492	7,517	33,829	20,280
2020	Circuit2739	70,225	27,903	21,431	39,853	25,047	739,770	489,103	417,974
2020	Circuit2740	127,593	54,693	16,289	66,192	14,578	12,069	32,984	19,877
2020	Circuit2741	71,435	127,150	94,057	97,547	175,689	462,767	75,023	237,826
2020	Circuit2742	327,232	731,659	46,366	368,419	16,825	665,190	19,028	233,681
2020	Circuit2744	26,434	41,690	98,547	55,557	132,709	52,335	31,720	72,255
2020	Circuit2745	11,598	18,572	18,765	16,312	9,104	12,689	23,755	15,182
2020	Circuit2746	30,537	310,364	8,877	116,593	103,286	37,114	14,784	51,728
2020	Circuit2752	12,134	17,648	20,591	16,791	22,429	231,106	127,682	127,072
2020	Circuit2753	1,969	14,592	25,707	14,089	20,692	3,164	22,078	15,311
2020	Circuit2754	132,008	17,630	199,403	116,347	9,645	6,948	146,780	54,458
2020	Circuit2755	6,244	9,136	21,553	12,311	10,021	1,222	24,291	11,845
2020	Circuit2756	30,509	101,084	5,722	45,772	1,377	8,774	4,835	4,995
2020	Circuit4087			-	-		-	-	#DIV/0!
2020	Circuit875	69,591	228,829	160,949	153,123	184,072	206,093	29,003	139,723
2020	Circuit876	41,805	17,666	160,976	73,482	136,145	37,822	103,867	92,611
2020	Circuit3712			-	-		-	-	#DIV/0!
2020	Circuit3716	49		-	25		-	-	#DIV/0!
2020	Circuit3587	84,528	183,614	135,509	134,550		0	-	-
2020	Circuit1701	1,463,010	96,202	198,439	585,884		0	-	-
2020	Circuit3588	52,790	35,930	116,626	68,449		0	-	-
2020	Circuit2060	19,726	625,184	99,420	248,110	2,143	18,412	40,640	20,398
2020	Circuit4088	20		-	10		-	-	#DIV/0!
2020	Circuit2790	452,834	32,782	26,657	170,758	44,661	128,054	14,682	62,466
2020	Circuit2791	74,607	36,152	78,072	62,944	62,520	67,137	65,829	65,162
2020	Circuit2792	220,223	126,061	356,850	234,378	63,977	65,118	130,252	86,449
2020	Circuit2794	195,975	137,137	34,442	122,518	34,035	114,137	300,268	149,480
2020	Circuit2807	3,536	71,248	151,266	75,350	315	3,074	2,498	1,962
2020	Circuit2808	10,671	5,332	68,449	28,151	7,180	30,252	24,429	20,620
2020	Circuit887	9,656	112,694	147,700	90,017	6,146	30,283	17,513	17,980
2020	Circuit888	299,537	144	22,410	107,364	104,670	11,901	4,374	40,315
2020	Circuit2063	111,718	40,678	108,179	86,858	16,642	54,232	335,765	135,546
2020	Circuit3718			-	-		-	-	#DIV/0!
2020	Circuit2067	8,149	15,085	5,785	9,673	972	1,897	3,922	2,264
2020	Circuit2068	134,656	93,237	340,796	189,563	170,544	37,149	73,099	93,597
2020	Circuit2070	108,084	52,976	200,668	120,576	42,225	214,924	19,380	92,176
2020	Circuit2071	39,092	64,458	17,350	40,300	27,150	7,913	33,573	22,879
2020	Circuit2072	20,297	102,783	24,452	49,177	2,532	6,122	6,385	5,013

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3740	874		-	437		-	-	#DIV/0!
2020	Circuit3622			-	-	160	-	-	160
2020	Circuit3643			-	-	1,103	0	-	551
2020	Circuit3623	21,726		66,447	44,087	80,433	-	-	80,433
2020	Circuit897	3,964	21,473	113	8,517		84	270	177
2020	Circuit901	20,298	7,448	6,568	11,438	25,006	4,413	24,943	18,121
2020	Circuit903	8,730	10,181	7,782	8,898	8,684	6,340	4,484	6,503
2020	Circuit3734	1,600		-	800		-	-	#DIV/0!
2020	Circuit1708	31,131	10,658	25,028	22,272	6,956	139,211	21,341	55,836
2020	Circuit1709	6,452	3,349	9,993	6,598	25,242	72,460	3,613	33,772
2020	Circuit2083	126,936	12,758	322,296	153,997	3,611	24,310	40,597	22,840
2020	Circuit2084	7,339	1,055	176,191	61,528	121,413	2,460	126,495	83,456
2020	Circuit2085	17,346	239,138	121,104	125,863	11,714	8,092	400,744	140,183
2020	Circuit2086	2,418		-	1,209		0	0	-
2020	Circuit3731			-	-		-	-	#DIV/0!
2020	Circuit2087	12,919	10,803	65,565	29,762	172,023	42,232	80,604	98,286
2020	Circuit2088	254,698	285,158	621,017	386,958	438,389	6,565	109,310	184,755
2020	Circuit1719			446	446		580	0	290
2020	Circuit1727	385		98	242	25	0	1,151	392
2020	Circuit1728	15,260	1,518	970	5,916	14,484	5,350	17,391	12,408
2020	Circuit1729		5,066	1,053	3,060	157	111	18,094	6,121
2020	Circuit1730	1,696		1,928	1,812	917	224	19	387
2020	Circuit1732	188,790	4,779	23,213	72,261	38,653	85,305	532,989	218,982
2020	Circuit1733	83,239	46,843	70,474	66,852	23,807	11,267	9,770	14,948
2020	Circuit1734	188,095	1,270,146	12,281	490,174	16,511	11,928	270,734	99,724
2020	Circuit1735	120,968	855,623	168,746	381,779	5,492	67,614	6,442	26,516
2020	Circuit1736	137,713	77,334	38,667	84,571	31,549	90,034	146,237	89,274
2020	Circuit1737	72,956	227,295	26,842	109,031	105,976	11,967	423,948	180,631
2020	Circuit1738	48,274	1,027,214	126,048	400,512	134,927	32,111	721,541	296,193
2020	Circuit1739	35,422	484,305	123,620	214,449	23,432	31,967	200,649	85,349
2020	Circuit2859	33,109	75,396	38,926	49,144	2,837	9,606	403,115	138,519
2020	Circuit1401	44,831	9,268	2,292	18,797	27,668	1,757	229,386	86,270
2020	Circuit1402	119,449	678,409	247,330	348,396	142,570	8,515	196,499	115,861
2020	Circuit3738	35		-	18		-	-	#DIV/0!
2020	Circuit2862	3,869		103	1,986	6,814	13	0	2,275
2020	Circuit2863	9,171	112	-	3,094	880	12,187	7,715	6,927
2020	Circuit2864	1,457	33,465	52,965	29,296	17,259	6,461	5,218	9,646
2020	Circuit2865	3,871	62,462	170,446	78,926	19,713	12,912	41,777	24,801
2020	Circuit2866	42,556	11,287	23,102	25,648	135,876	25,541	123,155	94,857
2020	Circuit2869	102,923	18,097	35,031	52,017	17,578	29,659	80,313	42,517
2020	Circuit2870	74,235	50,386	68,170	64,264	109,511	39,160	76,287	74,986
2020	Circuit2877	217,461	45,516	97,527	120,168	132,659	26,822	16,520	58,667
2020	Circuit2878	166,383		-	83,192		0	0	-
2020	Circuit2879	24,531	2,821	40,747	22,700	10,792	30,455	99,464	46,904

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit2881	67,906	93,521	134,944	98,790	11,854	68,441	26,555	35,616
2020	Circuit2882	7,029	38,576	21,715	22,440	2,087	4,623	320	2,343
2020	Circuit2884	822	16,086	46,283	21,064	4,681	52,555	103,722	53,652
2020	Circuit2885	27,613	75,342	147,854	83,603	113,762	157,081	74,536	115,126
2020	Circuit2886	141,972	30,318	3,149	58,480	8,352	5,482	19,785	11,207
2020	Circuit2887	67,538	70,980	179,602	106,040	10,281	1,088,576	6,559	368,472
2020	Circuit2888	4,805	6,498	133,084	48,129	11,081	531	45,575	19,062
2020	Circuit2889	3,977	3,402	68,666	25,348	94,278	96,265	59,389	83,311
2020	Circuit2890	12,780	20,743	84,437	39,320	3,678	114,602	25,960	48,080
2020	Circuit2895	3,695	82,825	7,798	31,439	51,338	1,867	6,716	19,973
2020	Circuit3727			-	-		-	-	#DIV/0!
2020	Circuit3719			-	-		-	-	#DIV/0!
2020	Circuit3590	1,010	3,823	2,433	2,422		0	-	-
2020	Circuit3591	1,240	4,871	2,204	2,772		0	-	-
2020	Circuit3592	31,402	118,114	101,000	83,505		0	-	-
2020	Circuit3594	1,422		8,438	4,930		0	-	-
2020	Circuit3595	79,752	215,030	220,166	171,649		0	-	-
2020	Circuit1752	9,828	4,622	13,265	9,238	20,024	38,805	9,031	22,620
2020	Circuit1753	14,270	1,277	4,481	6,676	16,253	69,724	31,100	39,026
2020	Circuit1759	10,534	1,703	21,933	11,390	34,793	99,721	277,442	137,319
2020	Circuit1754	189,954	13,666	4,082	69,234	210,477	59,897	78,264	116,213
2020	Circuit1755	85,962	13,945	8,396	36,101	7,607	89,485	5,699	34,264
2020	Circuit1756	6,733	76,386	535,306	206,142	83,046	193,448	18,857	98,450
2020	Circuit2932	53,132	121,347	238,997	137,825	84,307	32,893	66,085	61,095
2020	Circuit2933	474,141	26,664	44,865	181,890	24,338	15,129	257,857	99,108
2020	Circuit2934	33,351	19,753	27,153	26,752	62,414	35,371	260,481	119,422
2020	Circuit2935	17,166	82,743	245,868	115,259	221,679	83,044	64,659	123,127
2020	Circuit2936	2,350	22,183	46,013	23,515	15,525	6,186	7,339	9,683
2020	Circuit2937	3,572	180,136	36,501	73,403	31,221	23,843	5,800	20,288
2020	Circuit1250	995	1,349	15	786	1,041	2,306	201	1,182
2020	Circuit1252	17,288	5,772	8,757	10,606	2,757	122,450	6,780	43,996
2020	Circuit1253	55,892	32,227	21,848	36,656	38,779	43,390	52,273	44,814
2020	Circuit1255	19,222	15,066	32,154	22,147	500,305	251,465	103,485	285,085
2020	Circuit1256	449,523	74,838	22,367	182,243	320,897	299,470	50,456	223,608
2020	Circuit1257		4,097	22,302	13,200	107	8,487	4,774	4,456
2020	Circuit944	3,826	4,115	19,295	9,079	175,584	34,199	93,470	101,085
2020	Circuit945		11	63	37	596	0	0	199
2020	Circuit946	7,878	1,965	26,292	12,045	25,582	107,797	42,628	58,669
2020	Circuit947	105	4,958	15,630	6,898	81,175	1,439	0	27,538
2020	Circuit3649		114	-	57		0	-	-
2020	Circuit1766	205,468	25,981	1,453	77,634	3,688	42,941	169,467	72,032
2020	Circuit1768	763	3,389	7,019	3,724	44,713	46,293	769,375	286,794
2020	Circuit1769	2,070	1,439	1,222	1,577	417,183	339,655	230,276	329,038
2020	Circuit1771			10	10		0	881	441

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit1772	7,746	70,474	50,137	42,786	81,784	9,013	1,753	30,850
2020	Circuit1773	307,020	202,117	23,851	177,663	66,725	14,163	42,066	40,985
2020	Circuit1774	241,928	92,979	19,129	118,012	17,805	940	27,583	15,443
2020	Circuit948			-	-		0	0	-
2020	Circuit951	30,797	41,377	153,445	75,206	32,994	24,251	151,328	69,525
2020	Circuit952	243,841	411,900	34,922	230,221	22,674	37,318	63,628	41,206
2020	Circuit953	102,413	176,332	98,574	125,773	30,493	30,681	38,347	33,173
2020	Circuit954	445,752	141,600	440,765	342,706	149,621	10,084	173,536	111,080
2020	Circuit955	55,752	197,330	174,158	142,413	137,568	122,401	74,648	111,539
2020	Circuit4089			-	-		-	-	#DIV/0!
2020	Circuit2993	1,059	405	6	490		656	3,704	2,180
2020	Circuit2994	5,059		36	2,548	8,164	2,342	11,624	7,377
2020	Circuit2995	180,019	18,388	42,099	80,169	25,043	79,932	314,288	139,754
2020	Circuit2996	54,195	27,672	235,881	105,916	42,185	12,248	214,785	89,739
2020	Circuit2997	80,730	21,577	8,407	36,905	618,216	13,936	153,537	261,896
2020	Circuit2998	66,080	182,010	26,474	91,521	53,097	189,016	352,271	198,128
2020	Circuit2999	100,081	349,603	643,431	364,372	48,411	13,590	205,441	89,147
2020	Circuit3737	899		-	450		-	-	#DIV/0!
2020	Circuit3598			64,669	64,669		0	-	-
2020	Circuit3041	552	71,330	40,966	37,616	219,164	116,239	687,716	341,040
2020	Circuit3056	3,610	24,203	16,699	14,837	1,184	3,563	964	1,903
2020	Circuit3064	29,719	32,087	3,009	21,605	26,237	91,967	1,763	39,989
2020	Circuit3065	130,562	102,055	11,014	81,210	180,263	135,640	42,332	119,412
2020	Circuit3066	159,231	495,143	17,082	223,819	128,841	51,495	12,624	64,320
2020	Circuit3069		194	-	97	21	0	0	7
2020	Circuit1779	284,341	105,110	4,671	131,374	64,182	2,745	8,704	25,211
2020	Circuit3070	80,375	138,607	2,764	73,915	36,373	8,344	2,437	15,718
2020	Circuit3071	5,050	10,576	875,237	296,954	7,914	4,276	10,809	7,667
2020	Circuit3072	20,023	5,748	11,411	12,394	3,569	23,262	244,869	90,567
2020	Circuit3073	79,099	67,422	153,523	100,015	341,806	202,960	5,877	183,548
2020	Circuit3074	8,227	552,922	81,128	214,092	9,554	9,042	38,179	18,925
2020	Circuit1780	16,500	347	3,878	6,908	292,914	20,393	392,149	235,152
2020	Circuit1782		854	2,220	1,537	6,130	2,999	4,027	4,385
2020	Circuit1783		2,103	1,864	1,984	3,280	2,896	0	2,059
2020	Circuit1785	2,743	300	105	1,049	26,187	3,323	9,970	13,160
2020	Circuit1788			1,888	1,888	1,307	2,606	6,408	3,440
2020	Circuit1789	34,681	217,953	261,651	171,428	119,051	50,414	8,799	59,421
2020	Circuit1790	83,879	294,168	93,519	157,189	209,474	16,072	16,636	80,727
2020	Circuit1791	5,189	342,461	13,790	120,480	19,894	312,465	157,677	163,346
2020	Circuit1792	293,704	55,984	317,629	222,439	176,374	40,027	200,173	138,858
2020	Circuit1793	8,605	12,163	459	7,076	642,448	411,683	57,879	370,670
2020	Circuit1794	110,523	407,096	808,676	442,098	217,192	165,535	-	191,363
2020	Circuit1795		3,391	-	1,696	17,452	290,082	98,680	135,405
2020	Circuit3657	444		-	222		0	-	-

		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3606	135	1,322	1,763	1,073		0	-	-
2020	Circuit3607			-	-		0	-	-
2020	Circuit3608		89	104	97		0	0	-
2020	Circuit3609		113	1,586	850		3,197	-	3,197
2020	Circuit3660			243	243		0	-	-
2020	Circuit3713			-	-		-	-	#DIV/0!
2020	Circuit3662			-	-		0	-	-
2020	Circuit3663	1,404		-	702		0	-	-
2020	Circuit3611	26,520	13,145	33,202	24,289	58	9	-	33
2020	Circuit3714			-	-		-	-	#DIV/0!
2020	Circuit3096			7,499	7,499	10,724	647	947	4,106
2020	Circuit3097	66,891	8,701	123,333	66,308	295,977	267,737	219,981	261,232
2020	Circuit3099	33,917	5,918	281,805	107,213	99,920	137,167	38,793	91,960
2020	Circuit3100	46,026	43,507	94,778	61,437	215,421	145,133	203,452	188,002
2020	Circuit3101	819,270	178,942	264,080	420,764	225,064	26,597	289,328	180,330
2020	Circuit3102	13,534	20,495	133,528	55,852	1,278	49,450	156,945	69,225
2020	Circuit1798	199,974	52,181	661,371	304,509	197,061	46,895	137,780	127,245
2020	Circuit1799	158,577	102,844	219,402	160,274	41,294	91,890	95,401	76,195
2020	Circuit1800	25,490	107,222	163,244	98,652	303,011	19,633	73,886	132,177
2020	Circuit1801	294,939	112,263	191,755	199,652	48,969	44,625	21,848	38,481
2020	Circuit1802	104,802	66,631	863,990	345,141	12,404	13,763	58,992	28,386
2020	Circuit1803	2,468		3,915	3,192	2,719	2,389	1,057	2,055
2020	Circuit1804	61,786	61,698	439,014	187,499	90,846	112,637	171,914	125,132
2020	Circuit1805			1,125	1,125		0	2,907	1,454
2020	Circuit3124		239	3,972	2,106	1,569	1,113	635	1,106
2020	Circuit3126	13,860	1,574	182	5,205		75	587	331
2020	Circuit3131	37,719	55,966	42,388	45,358	130,378	40,839	467,208	212,808
2020	Circuit4090	258		-	129		-	-	#DIV/0!
2020	Circuit1812	940	2,326	9,170	4,145	11,793	28,238	29,714	23,248
2020	Circuit1815	2,363	7,123	5,900	5,129	254	0	548	267
2020	Circuit1816			67	67		429	669	549
2020	Circuit1817			-	-	195	553	494	414
2020	Circuit1818	1,138	399	553	697		275	258	267
2020	Circuit1819	2,034	970	5,894	2,966	3,549	265	19,067	7,627
2020	Circuit1820	96,511	7,680	70,400	58,197	35,201	16,976	15,379	22,518
2020	Circuit1821	545,129	1,252,964	393,696	730,596	1,012	8,884	29,674	13,190
2020	Circuit1822	6,227	1,765	37,647	15,213	2,711	1,078	13,908	5,899
2020	Circuit1823	3,275	274,819	271,891	183,328	50,183	7,071	36,192	31,149
2020	Circuit1824	31,758	53,183	101,210	62,050	139,004	232,985	165,793	179,261
2020	Circuit1825	484,533	143,830	504,024	377,462	60,928	86,838	166,253	104,673
2020	Circuit1826	74	76,112	363,598	146,595	11,727	308	103,203	38,413
2020	Circuit3156			-	-		0	0	-
2020	Circuit1827	145	2,091	3,503	1,913	336,707	5,367	4,117	115,397
2020	Circuit1828	55,710	284,793	56,128	132,210	10,636	1,659	23,441	11,912

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		EX MEDs CMI Control Group							
Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit1829	1,816	58,252	54,863	38,310	3,369	138,478	13,571	51,806
2020	Circuit1830	66,772	15,212	96,290	59,425	316,067	25,640	75,748	139,152
2020	Circuit3184	3,232	192	1,989	1,804	278	211	5,577	2,022
2020	Circuit3185	6,067	277,052	529,922	271,014	25,922	204,110	104,899	111,644
2020	Circuit3186	5,449	156,751	110,650	90,950	10,601	49,214	50,117	36,644
2020	Circuit3187	323,628	13,805	7,318	114,917	66,570	31,036	76,413	58,006
2020	Circuit3188	4,521	54,018	167,394	75,311	119,737	67,049	11,499	66,095
2020	Circuit3189	84		-	42		0	0	-
2020	Circuit3190	4,687	7,100	2,063	4,617	30,025	20,139	6,828	18,997
2020	Circuit3192	27,373	187,697	155,304	123,458	26,318	111,442	4,022	47,261
2020	Circuit3193	22,547	80,396	134,736	79,226	72,681	20,318	56,274	49,758
2020	Circuit3194	35,026	125,618	749,798	303,481	13,820	91,696	165,906	90,474
2020	Circuit3195	89,391	48,712	85,714	74,606	66,143	323,991	35,155	141,763
2020	Circuit1839	10,832	24,506	6,830	14,056	1,028,010	5,326	12,584	348,640
2020	Circuit1845	172,234	13,554	27,479	71,089	44,679	3,516	3,156	17,117
2020	Circuit1846	30,568	95,867	76,303	67,579	11,641	4,341	12,645	9,543
2020	Circuit1847	6,652		-	3,326	9,538	88,459	0	32,665
2020	Circuit1848	85,053	119,072	3,121	69,082	96,078	1,554	33,095	43,576
2020	Circuit1849	117,264	55,119	354,211	175,531	2,229	67,284	13,635	27,716
2020	Circuit1850	38	1,011	-	350	252	0	206	153
2020	Circuit1851	207,170	114,556	79,526	133,751	30,151	28,080	71,991	43,407
2020	Circuit1852	9,393	19,096	166	9,552	17	7	0	8
2020	Circuit1853	848	1,910	22,975	8,578	11,163	5,307	10,169	8,880
2020	Circuit1854	12,338	42,258	38,560	31,052	39,600	48,892	372	29,621
2020	Circuit1434	158,325	122,157	255,031	178,504	148,126	270,516	20,545	146,396
2020	Circuit4091			-	-		-	-	#DIV/0!
2020	Circuit3717			-	-		-	-	#DIV/0!
2020	Circuit3735	1,903		-	952		-	-	#DIV/0!
2020	Circuit3677			-	-		0	-	-
2020	Circuit2150	282,320	448,483	452,959	394,587	63,745	290,330	265,578	206,551
2020	Circuit3721			-	-		-	-	#DIV/0!
2020	Circuit3314		2,011	-	1,006		0	549	274
2020	Circuit3316	4,195	27,234	3,253	11,561	7,684	1,482	3,142	4,103
2020	Circuit3317	3,892	4,927	42,660	17,160	2,029	65,134	178,455	81,873
2020	Circuit3318	9,077	5,640	1,610	5,442	1,096	1,593	12,042	4,910
2020	Circuit3319	1,553	4,739	11,255	5,849	1,773	10,130	8,668	6,857
2020	Circuit3320	28,698	13,399	21,111	21,069	36,285	19,276	8,643	21,401
2020	Circuit3321	2,138	3,659	32,268	12,688	37,206	22,922	88,084	49,404
2020	Circuit3322	923	1,606	291	940	6,369	251	9,294	5,305
2020	Circuit3323	8,354	214	576	3,048	13,428	1,550	18,101	11,027
2020	Circuit3324	2,315	1,460	36,897	13,557	5,273	12,633	8,854	8,920
2020	Circuit3395	78,591	753,459	336,086	389,379	68,298	42,522	122,542	77,787
2020	Circuit3397	14,561	3,918	45,073	21,184	25,299	27,957	4,152	19,136
2020	Circuit3398	100,476	2,904	8,461	37,280	17,745	6,042	56,434	26,740

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		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3399			-	-	1,218	126	105	483
2020	Circuit3400	226,102	60,676	67,639	118,139	32,630	132,646	44,273	69,849
2020	Circuit3724			-	-		-	-	#DIV/0!
2020	Circuit1461			152	152		0	0	-
2020	Circuit1926	3,698	1,518	18,507	7,908	4,789	28	1,651	2,156
2020	Circuit1009	2,997	4,313	3,094	3,468	79,566	8,868	186,284	91,572
2020	Circuit1010	159,215	43,819	169,843	124,292	74,586	36,299	11,288	40,724
2020	Circuit1012	26,691	3,905	89,209	39,935	104,738	4,279	127,912	78,976
2020	Circuit1013	214,338	106,882	126,542	149,254	176,636	12,046	4,864	64,515
2020	Circuit1014	6,192	186,124	106,246	99,521	80,005	52,549	20,323	50,959
2020	Circuit1016	730,789	74,244	77,457	294,163	292,952	86,939	85,653	155,182
2020	Circuit1017	173,025	3,822	21,964	66,270	746,022	53,480	72,617	290,707
2020	Circuit1018	3,095	5,129	87,523	31,916	6,843	692	8,166	5,234
2020	Circuit1019	248,968	81,424	20,751	117,048	9,823	21,582	4,958	12,121
2020	Circuit1022	521,134	277,424	22,769	273,776	36,031	9,902	27,144	24,359
2020	Circuit1023	19,478	54,082	151,180	74,913	55,078	10,890	24,285	30,084
2020	Circuit3732			-	-		-	-	#DIV/0!
2020	Circuit1030		2,410	968	1,689	97,352	111	529	32,664
2020	Circuit3725			-	-		-	-	#DIV/0!
2020	Circuit3726			-	-		-	-	#DIV/0!
2020	Circuit1037	38		-	19		0	0	-
2020	Circuit3729	7,222		-	3,611		-	-	#DIV/0!
2020	Circuit3484	3,690	301	63	1,351	5,791	49,672	660	18,708
2020	Circuit3722			-	-		-	-	#DIV/0!
2020	Circuit3486	8,911	12,298	454	7,221	1,233	248	18,280	6,587
2020	Circuit3487	2,250	2,552	26,569	10,457	16,779	424	4,480	7,228
2020	Circuit3488	278	12,139	845	4,421	217	8,212	12,397	6,942
2020	Circuit3489		46,853	34,142	40,498	93,432	13,341	54,348	53,707
2020	Circuit3490	12,350	57,868	24,805	31,674	264,742	21,345	23,237	103,108
2020	Circuit3690	1,430		-	715		-	-	#DIV/0!
2020	Circuit3491	82,515	289,375	160,527	177,472	55,544	20,260	27,323	34,376
2020	Circuit3492	78,996	6,442	12,769	32,736	16,614	1,099	56,934	24,882
2020	Circuit3493	28,699	94,013	81,467	68,060	41,766	29,997	18,815	30,193
2020	Circuit3495	18,435	19,038	10,866	16,113	6,243	75,765	4,707	28,905
2020	Circuit3496	941	4,577	14,349	6,622	381,925	601,913	349	328,062
2020	Circuit3497	117,362	45,951	126,839	96,717	192,853	140,604	137,733	157,063
2020	Circuit3498	70,347	8,623	31,051	36,674	6,396	96,953	6,031	36,460
2020	Circuit3499	12,554	128,667	5,447	48,889	26,474	155,716	58,444	80,211
2020	Circuit3501	225,442	66,117	18,302	103,287	237,364	105,778	33,737	125,626
2020	Circuit3502	241,252	25,301	186,516	151,023	46,482	122,966	54,503	74,650
2020	Circuit3503	9,164	590,297	10,026	203,162	81,370	93,554	137,690	104,205
2020	Circuit3509	246,345	6,980	49,843	101,056	132,108	6,989	25,702	54,933
2020	Circuit3510	45,369	11,764	48,106	35,080	21,818	71,479	13,492	35,596
2020	Circuit3511	3,950	16,024	7,061	9,012	293,423	13,283	29,159	111,955

Year	Circuit	EX MEDs CMI Control Group							
		3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	Circuit3513		61,103	4,660	32,882	4,661	8,842	264	4,589
2020	Circuit3723			-	-		-	-	#DIV/0!
2020	Circuit3535			-	-		0	0	-
2020	Circuit3686	257		-	129		0	-	-
2020	Circuit3536			-	-	205	594	0	266
2020	Circuit3537	4,531	24,703	10,030	13,088	1,284	6,743	6,185	4,738
2020	Circuit3688		10,293	-	5,147		0	-	-
2020	Circuit3619	35,599	203,412	49,563	96,191		0	-	-
2020	Circuit3621	463,431	9,406	63,289	178,709		0	-	-
2020	Circuit2376			-	-	20,515	41,636	57,405	39,852
2020	Circuit2377		120	867	494	131,167	51,389	508,767	230,441
2020	Circuit2378			1,514	1,514	87,503	22,943	89,701	66,716

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Total 2018-2020			594,749	667,821	816,068	692,879	886,869	832,451	927,270	882,197
All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit3715	11	2	1	5	0	0	0	0
2018	2018	Circuit3720	1		1	1	0	0	0	0
2018	2018	Circuit206	5	7	832	281		517	19	268
2018	2018	Circuit208	42	32	259	111		798	51	425
2018	2018	Circuit209	2716	5365	5927	4669		2,365	27	1196
2018	2018	Circuit211	114	160	246	173		2,822	122	1472
2018	2018	Circuit2434	10	7	13	10	37	124	28	63
2018	2018	Circuit2436	948	211	1768	976	128	177	860	388
2018	2018	Circuit2438	2	1	131	45	189	20	7	72
2018	2018	Circuit2439	608	8	1987	868	39	210	901	383
2018	2018	Circuit3624			1	1	0	0	0	0
2018	2018	Circuit2440	221	45	587	284	14	55	215	95
2018	2018	Circuit2441	2	1		2	7	3	1	4
2018	2018	Circuit2442	1916	961	294	1057	1108	1,184	1,503	1265
2018	2018	Circuit2443	95	44	672	270	163	258	111	177
2018	2018	Circuit2444	6	820	723	516	57	63	1,494	538
2018	2018	Circuit2445	86	13	628	242	806	28	566	467
2018	2018	Circuit2446	21	626	46	231	273	45	878	399
2018	2018	Circuit2447	404	66	14	161	485	1,135	423	681
2018	2018	Circuit2455	1	2	2	2	0	42	2	15
2018	2018	Circuit2460	1	1	1	1	73	25	297	132
2018	2018	Circuit2466			3	3	0	1	0	0
2018	2018	Circuit2472	4	1	37	14	8	16	133	52
2018	2018	Circuit2473	8	192	570	257	774	1,015	864	884
2018	2018	Circuit2474	1141	7	22	390	168	658	8	278
2018	2018	Circuit1595			1	1	0	0	0	0
2018	2018	Circuit1596			18	18	7	34	4	15
2018	2018	Circuit1597	3	4	194	67	50	86	75	70
2018	2018	Circuit1598	335	264	787	462	1098	1,176	818	1031
2018	2018	Circuit1599	10	16	688	238	1018	322	896	745
2018	2018	Circuit1600	2664	88	263	1005	3178	283	1,483	1648
2018	2018	Circuit1601	290	314	2589	1064	909	1,243	1,497	1216
2018	2018	Circuit1602	9	14	59	27	52	66	432	183
2018	2018	Circuit1603	127	41	115	94	193	560	14	256
2018	2018	Circuit1604	2078	965	39	1027	663	657	201	507
2018	2018	Circuit1605	361	123	195	226	1108	1,194	1,153	1152
2018	2018	Circuit1606	144	671	428	414	979	1,222	761	987
2018	2018	Circuit1607	85	104	2002	730	1266	186	420	624
2018	2018	Circuit3741			11	11	0	0	0	0
2018	2018	Circuit1219	140	282	129	184	1229	1,285	959	1158
2018	2018	Circuit2015			170	170	70	426	84	193
2018	2018	Circuit2016	128	7	1933	689	157	2,915	349	1140

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit2017	592	28	883	501	188	3,256	144	1196
2018	2018	Circuit2019	24	3	23	17	13	58	43	38
2018	2018	Circuit2020	560	173	186	306	42	216	354	204
2018	2018	Circuit2021		184		184	0	0	0	0
2018	2018	Circuit2022	1517	155	1621	1098	1055	1,273	973	1100
2018	2018	Circuit2023	1018	75	1128	740	439	1,801	1,508	1249
2018	2018	Circuit2024	398	299	1318	672	23	678	647	449
2018	2018	Circuit2025	795	51	1318	721	214	654	1,019	629
2018	2018	Circuit1622	741	162	1410	771	271	960	1,392	874
2018	2018	Circuit1623	731	137	477	448	14	639	818	490
2018	2018	Circuit1624	4557	222	3980	2920	2231	1,903	104	1413
2018	2018	Circuit1625	1		1	1	0	12	11	8
2018	2018	Circuit1626	612	13	856	494	686	897	781	788
2018	2018	Circuit1627	1456	17	52	508	1168	832	1,061	1020
2018	2018	Circuit3728		37		37	0	0	0	0
2018	2018	Circuit1629	7	63	28	33	13	185	458	219
2018	2018	Circuit1630	926	70	1840	945	1000	191	887	693
2018	2018	Circuit1631	86	151	108	115	117	89	1,312	506
2018	2018	Circuit1632	227	111	92	143	100	186	1,173	486
2018	2018	Circuit1633	320	867	2019	1069	45	90	2,252	796
2018	2018	Circuit2559	669	4	251	308	162	399	671	411
2018	2018	Circuit1634	242	513	193	316	208	326	603	379
2018	2018	Circuit2566	4	220	174	133	185	441	283	303
2018	2018	Circuit1392	212	152	1603	656	1385	0	0	462
2018	2018	Circuit3761	389	160	1	183	0	0	0	0
2018	2018	Circuit2578	1218	703	1531	1151	1668	2,310	2,166	2048
2018	2018	Circuit2579	6	171	82	86	1799	1,560	2,051	1803
2018	2018	Circuit3730		1		1	0	0	0	0
2018	2018	Circuit1237	3	138	4	48	8	320	89	139
2018	2018	Circuit1238		1		1	0	0	0	0
2018	2018	Circuit1239	5	8	27	13	29	514	193	245
2018	2018	Circuit1240	9	523	138	223	585	480	1	355
2018	2018	Circuit1242	4	376	70	150	378	947	67	464
2018	2018	Circuit1243	11	304	441	252	638	893	415	649
2018	2018	Circuit1244	57	668	5	243	640	618	116	458
2018	2018	Circuit1245	13	9	180	67	580	621	199	467
2018	2018	Circuit1246	80	55	625	253	303	582	39	308
2018	2018	Circuit3710	1			1	0	0	0	0
2018	2018	Circuit820	7		24	16	2	20	0	7
2018	2018	Circuit825			6	6	4	0	6	3
2018	2018	Circuit826		61	90	76	1	17	27	15
2018	2018	Circuit827	12	1	187	67	82	136	5	74
2018	2018	Circuit828	2399	1356	2352	2036	2341	3,413	541	2098
2018	2018	Circuit829	166	123	3840	1376	3628	3,919	309	2619

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		All Weather CI Control Group								
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit830	584	530	969	694	1974	2,165	347	1495
2018	2018	Circuit831	3	2	29	11	29	35	5	23
2018	2018	Circuit832	552	791	1843	1062	423	2,067	908	1133
2018	2018	Circuit833	220	179	660	353	1000	2,326	44	1123
2018	2018	Circuit834	105	24	463	197	39	671	752	487
2018	2018	Circuit835	55	78	2443	859	713	1,022	1,095	943
2018	2018	Circuit836	808	65	1303	725	2604	756	210	1190
2018	2018	Circuit837	11	5	212	76	25	4	245	91
2018	2018	Circuit838	1475	462	2292	1410	818	2,205	411	1145
2018	2018	Circuit1641	69	21	126	72	20	23	149	64
2018	2018	Circuit1646	841	83	228	384	174	208	154	179
2018	2018	Circuit1642	1258	94	833	728	1686	1,669	313	1223
2018	2018	Circuit1647	2690	95	3516	2100	1080	773	1,371	1075
2018	2018	Circuit1643	912	152	3531	1532	1370	352	113	612
2018	2018	Circuit1648	2599	232	105	979	1591	1,349	425	1122
2018	2018	Circuit1644	162	976	616	585	3087	1,415	428	1643
2018	2018	Circuit1645	78	319	449	282	539	91	297	309
2018	2018	Circuit1649	298	129	1047	491	537	154	328	340
2018	2018	Circuit55	83	44	2239	789	264	400	560	408
2018	2018	Circuit57	13	586	2001	867	1600	155	767	841
2018	2018	Circuit59	1587	1076	374	1012	250	921	1,127	766
2018	2018	Circuit60	216	2123	1527	1289	1152	302	750	735
2018	2018	Circuit62	450	713	563	575	525	589	56	390
2018	2018	Circuit63	197	1432	3463	1697	2942	370	562	1291
2018	2018	Circuit64	97	280	3045	1141	646	3,554	628	1609
2018	2018	Circuit3578	552	37	624	404	0	0	0	0
2018	2018	Circuit2679				#DIV/0!	0	3	14	6
2018	2018	Circuit2681				#DIV/0!	6	978	217	400
2018	2018	Circuit3736			2342	2342	0	0	0	0
2018	2018	Circuit3733		1		1	0	0	0	0
2018	2018	Circuit1663	31	743	312	362	98	302	911	437
2018	2018	Circuit1664	1040	45	842	642	67	38	885	330
2018	2018	Circuit1665	5	523	585	371	33	1,714	703	817
2018	2018	Circuit1666	153	4036	6334	3508	132	4,268	1,339	1913
2018	2018	Circuit1668	113	192	329	211	36	216	1,614	622
2018	2018	Circuit1669	241	1046	269	519	81	5,228	1,132	2147
2018	2018	Circuit852	699	3	748	483	137	793	614	515
2018	2018	Circuit853	21	32	276	110	170	44	64	93
2018	2018	Circuit854	329	92	515	312	481	2,528	1,254	1421
2018	2018	Circuit855	49	69	2048	722	845	1,731	590	1055
2018	2018	Circuit856	1		26	14	0	1	0	0
2018	2018	Circuit857	1315	1009	1812	1379	2949	647	551	1382
2018	2018	Circuit858	1	53	43	32	133	13	0	49
2018	2018	Circuit859	46	319	355	240	349	188	390	309

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit3743			1	1	0	0	0	0
2018	2018	Circuit860	216	242	2711	1056	3259	2,490	1,786	2512
2018	2018	Circuit861	382	175	762	440	2091	1,973	145	1403
2018	2018	Circuit862	525	541	267	444	116	102	147	122
2018	2018	Circuit863	834	43	792	556	1036	219	2,197	1151
2018	2018	Circuit864	688	35	8	244	134	51	40	75
2018	2018	Circuit865	592	121	1553	755	821	1,953	694	1156
2018	2018	Circuit3742			1	1	0	0	0	0
2018	2018	Circuit3739			1	1	0	0	0	0
2018	2018	Circuit3711	1			1	0	0	0	0
2018	2018	Circuit1684	24	37	524	195	21	508	599	376
2018	2018	Circuit1685	8	6	2198	737	1043	64	1,186	764
2018	2018	Circuit1686	36	442	1307	595	22	107	1,512	547
2018	2018	Circuit1687	642	58	794	498	60	58	957	358
2018	2018	Circuit1688	95	140	1457	564	2383	1,602	111	1365
2018	2018	Circuit2729			1	1	1	1	0	1
2018	2018	Circuit2730	1			1	0	5	0	2
2018	2018	Circuit2732				#DIV/0!	0	3	0	1
2018	2018	Circuit2733	1	1		1	3	2	57	21
2018	2018	Circuit2734	6	141	413	187	52	27	750	276
2018	2018	Circuit2737	697	71	1302	690	124	1,793	97	671
2018	2018	Circuit2738	30	3	364	132	59	35	275	123
2018	2018	Circuit2739	15	214	1070	433	142	1,013	477	544
2018	2018	Circuit2740	842	32	1838	904	130	87	1,326	514
2018	2018	Circuit2741	539	41	819	466	163	807	1,351	774
2018	2018	Circuit2742	1110	41	1585	912	123	5,791	353	2089
2018	2018	Circuit2744	114	24	943	360	1727	113	1,001	947
2018	2018	Circuit2745	807	42	36	295	133	26	81	80
2018	2018	Circuit2746	966	134	71	390	118	461	328	302
2018	2018	Circuit2752	12	84	101	66	103	458	120	227
2018	2018	Circuit2753	147	54	11	71	227	79	245	184
2018	2018	Circuit2754	174	46	499	240	1170	247	113	510
2018	2018	Circuit2755	156	17	115	96	457	61	143	220
2018	2018	Circuit2756	5	4	53	21	30	56	27	38
2018	2018	Circuit4087		1		1	0	0	0	0
2018	2018	Circuit875	1451	377	886	905	1505	766	2,581	1617
2018	2018	Circuit876	52	1174	1278	835	568	1,310	1,332	1070
2018	2018	Circuit3712	4			4	0	0	0	0
2018	2018	Circuit3716	0		1	1	0	0	0	0
2018	2018	Circuit1698	329	646	799	591	2372	68	1,650	1363
2018	2018	Circuit3587	854	755	1014	874	345	10	0	118
2018	2018	Circuit1699	353	1093	1234	893	2769	130	79	993
2018	2018	Circuit1700	44	144	1599	596	2051	64	550	888
2018	2018	Circuit1701	261	2899	2611	1924	1684	0	0	561

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit3588	201	397	743	447	1141	0	0	380
2018	2018	Circuit2056		1	7	4	36	1	6	14
2018	2018	Circuit2057			2	2	13	0	4	6
2018	2018	Circuit2059	1716	204	948	956	1605	1,555	737	1299
2018	2018	Circuit2060	5	1880	263	716	1320	171	22	504
2018	2018	Circuit2061	80	187	1527	598	2251	265	792	1103
2018	2018	Circuit2062	184	671	45	300	1656	267	12	645
2018	2018	Circuit4088			1	1	0	0	0	0
2018	2018	Circuit1702	101	2832	997	1310	853	719	803	792
2018	2018	Circuit1703	137	4280	2082	2166	3561	364	317	1414
2018	2018	Circuit1704	141	186	2981	1103	601	2,229	1,889	1573
2018	2018	Circuit2790	100	57	1281	479	140	383	1,075	533
2018	2018	Circuit2791	123	507	263	298	446	407	613	489
2018	2018	Circuit2792	100	170	2264	845	1595	819	2,728	1714
2018	2018	Circuit2794	419	426	856	567	217	208	893	439
2018	2018	Circuit2796		46	1	24	5	44	3	17
2018	2018	Circuit2801	605	573	592	590	1219	794	1,443	1152
2018	2018	Circuit2802	12			12	0	0	0	0
2018	2018	Circuit2803	40			40	8	7	8	8
2018	2018	Circuit2804	10	785	18	271	870	876	232	659
2018	2018	Circuit2805	15	19	875	303	23	182	915	373
2018	2018	Circuit2806	1	131	32	55	9	140	241	130
2018	2018	Circuit2807	7	1448	8	488	819	788	20	542
2018	2018	Circuit2808	14	42	696	251	825	112	1,199	712
2018	2018	Circuit2810	1	205	1	69	8	208	18	78
2018	2018	Circuit879		2	2	2	3	4	11	6
2018	2018	Circuit880		7		7	0	0	1	0
2018	2018	Circuit882	2	4	7	4	0	0	0	0
2018	2018	Circuit883	2			2	1	3	2	2
2018	2018	Circuit884	1	2	2	2	9	0	2	4
2018	2018	Circuit886	1	1	36	13	4	12	1	6
2018	2018	Circuit887	161	21	66	83	311	925	841	692
2018	2018	Circuit888	488	111	1159	586	199	286	610	365
2018	2018	Circuit889	126	825	885	612	2043	1,847	2,056	1982
2018	2018	Circuit892	408	15	710	378	2420	768	832	1340
2018	2018	Circuit893	9	92	334	145	159	38	175	124
2018	2018	Circuit2063	9	335	1275	540	388	2,604	218	1070
2018	2018	Circuit3718	1			1	0	0	0	0
2018	2018	Circuit2067	74		53	64	33	26	435	165
2018	2018	Circuit2068	156	171	693	340	917	1,390	2,783	1697
2018	2018	Circuit2069	522	72	199	264	773	346	3,683	1601
2018	2018	Circuit2070	736	40	270	349	509	543	2,218	1090
2018	2018	Circuit2071	1094	60	190	448	235	468	1,260	654
2018	2018	Circuit2072	113	28	481	207	82	538	920	513

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit3740			1	1	0	0	0	0
2018	2018	Circuit2076	63	29	98	63	82	563	330	325
2018	2018	Circuit2077	23	21	500	181	537	57	1,051	548
2018	2018	Circuit2078	111	56	950	372	903	153	739	598
2018	2018	Circuit2079		1	40	21	0	0	0	0
2018	2018	Circuit2080	377	586	80	348	1370	13	82	488
2018	2018	Circuit2081	40	53	51	48	254	202	556	337
2018	2018	Circuit2082	86	1591	154	610	300	666	83	350
2018	2018	Circuit895			1	1	1	4	1	2
2018	2018	Circuit3622				#DIV/0!	0	0	0	0
2018	2018	Circuit3643				#DIV/0!	0	0	1	0
2018	2018	Circuit896				#DIV/0!	0	1	0	0
2018	2018	Circuit3623		121	207	164	195	0	0	65
2018	2018	Circuit897		4	153	79	9	23	1	11
2018	2018	Circuit901	149	2	136	96	31	5	88	41
2018	2018	Circuit903	41	38	66	48	19	186	132	112
2018	2018	Circuit904	133	380	100	204	2343	186	940	1156
2018	2018	Circuit3734		35	4	20	0	0	0	0
2018	2018	Circuit1708	1316	1630	1169	1372	1213	1,313	155	894
2018	2018	Circuit1713	332	1238	1425	998	1500	290	214	668
2018	2018	Circuit1709	55	720	865	547	85	653	151	296
2018	2018	Circuit1712	322	711	362	465	119	35	474	209
2018	2018	Circuit1715	348	572	795	572	502	155	310	322
2018	2018	Circuit2083	1119	550	934	868	2551	2,400	55	1669
2018	2018	Circuit2084	146	1551	604	767	1066	2,303	1,716	1695
2018	2018	Circuit2085	1748	2595	99	1481	880	2,411	96	1129
2018	2018	Circuit2086		91	2069	1080	0	0	0	0
2018	2018	Circuit3731		1		1	0	0	0	0
2018	2018	Circuit2087	55	32	31	39	518	1,596	3,006	1707
2018	2018	Circuit2088	2773	849	1149	1590	3844	2,843	5,074	3920
2018	2018	Circuit910		5		5	0	0	0	0
2018	2018	Circuit911		3		3	13	3	13	10
2018	2018	Circuit912	11	5	1	6	35	4	11	17
2018	2018	Circuit913	24	677	114	272	790	102	59	317
2018	2018	Circuit916	15	4	157	59	942	87	29	353
2018	2018	Circuit919	1967	5308	383	2553	1279	1,683	159	1040
2018	2018	Circuit1717	3	1	1	2	0	0	0	0
2018	2018	Circuit1719				#DIV/0!	3	0	1	1
2018	2018	Circuit1721	5			5	0	0	0	0
2018	2018	Circuit1727		36	5	21	1	48	1	17
2018	2018	Circuit1728	98	11	6	38	53	180	209	147
2018	2018	Circuit1729		5		5	2	1	5	3
2018	2018	Circuit1730	1	2	19	7	12	4	11	9
2018	2018	Circuit1732	2091	1552	1131	1591	202	514	281	332

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit1733	2404	981	1811	1732	324	1,141	1,107	857
2018	2018	Circuit1734	2790	913	1773	1825	155	2,025	1,104	1095
2018	2018	Circuit1735	2557	732	1342	1544	1739	1,143	1,845	1576
2018	2018	Circuit1736	2078	27	1019	1041	1690	787	1,267	1248
2018	2018	Circuit1737	2084	88	175	782	1414	164	1,044	874
2018	2018	Circuit1738	2669	637	1159	1488	1208	1,274	3,202	1895
2018	2018	Circuit1739	1556	24	258	613	449	94	1,341	628
2018	2018	Circuit933	25	35	17	26	135	224	45	135
2018	2018	Circuit934	225	19	198	147	1474	651	1,733	1286
2018	2018	Circuit935	356	29	490	292	3211	310	748	1423
2018	2018	Circuit936	30	23	761	271	132	83	138	118
2018	2018	Circuit937	479	124	149	251	1438	243	229	637
2018	2018	Circuit938	218	128	312	219	183	1,104	1,396	894
2018	2018	Circuit939	334	3053	336	1241	3279	123	428	1277
2018	2018	Circuit2859	760	1677	406	948	330	64	61	152
2018	2018	Circuit1401	12	33	394	146	11	120	892	341
2018	2018	Circuit1402	169	799	171	380	695	401	1,448	848
2018	2018	Circuit3738			1	1	0	0	0	0
2018	2018	Circuit2862	36		3	20	2	2	21	8
2018	2018	Circuit2863	23	24	33	27	1	5	31	12
2018	2018	Circuit2864	3	153	42	66	388	26	270	228
2018	2018	Circuit2865	605	75	772	484	333	904	180	472
2018	2018	Circuit2866	191	221	123	178	865	368	439	557
2018	2018	Circuit2868	238	12	163	138	1726	415	310	817
2018	2018	Circuit2869	47	584	652	428	892	35	684	537
2018	2018	Circuit2870	150	1031	1419	867	1416	636	1,512	1188
2018	2018	Circuit2877	31	107	857	332	1104	1,147	2,167	1473
2018	2018	Circuit2878			2863	2863	0	0	0	0
2018	2018	Circuit2879		362	740	551	592	611	581	595
2018	2018	Circuit2881	482	401	332	405	1521	1,344	1,415	1427
2018	2018	Circuit2882	15	68	57	47	324	340	317	327
2018	2018	Circuit2884	78	1805	2	628	477	283	110	290
2018	2018	Circuit2885	74	134	202	137	2286	1,948	3,826	2687
2018	2018	Circuit2886	96	735	820	550	804	40	742	529
2018	2018	Circuit2887	21	67	570	219	1481	1,391	1,136	1336
2018	2018	Circuit2888	2	31	17	17	1297	2,123	1,648	1689
2018	2018	Circuit2889	136	1296	10	481	2446	142	1,634	1407
2018	2018	Circuit2890	2	761	136	300	730	164	772	555
2018	2018	Circuit2894	401	76	1087	521	610	151	1,975	912
2018	2018	Circuit2895	46	26	66	46	37	135	1,084	419
2018	2018	Circuit1740	2			2	4	1	3	3
2018	2018	Circuit1741	1818	254	1425	1166	2408	91	1,511	1337
2018	2018	Circuit1743	6642	205	2827	3225	3748	2,008	2,787	2848
2018	2018	Circuit1745	876	487	31	465	494	205	1,041	580

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit1746	1216	194	3009	1473	2248	130	5,372	2583
2018	2018	Circuit1748	764	1423	665	951	1311	529	1,584	1141
2018	2018	Circuit1749	1128	98	1895	1040	1390	1,270	4,236	2299
2018	2018	Circuit1750	1141	422	1185	916	1109	1,691	1,392	1397
2018	2018	Circuit1751	1095	46	2971	1371	3324	1,077	1,978	2126
2018	2018	Circuit3727	1	1		1	0	0	0	0
2018	2018	Circuit3719	1			1	0	0	0	0
2018	2018	Circuit3590	18		5	12	20	0	0	7
2018	2018	Circuit3591	53	38	16	36	46	0	0	15
2018	2018	Circuit3592	943	3011	60	1338	492	0	0	164
2018	2018	Circuit3594	1795	743	7	848	40	0	0	13
2018	2018	Circuit3595	1479	477	1091	1016	1397	0	0	466
2018	2018	Circuit1752	138	17	637	264	63	28	466	186
2018	2018	Circuit1753	16	23	98	46	28	104	179	104
2018	2018	Circuit1759	718	661	1147	842	196	1,270	762	743
2018	2018	Circuit1754	704	86	184	325	24	473	1,456	651
2018	2018	Circuit1755	137	2	431	190	68	19	760	282
2018	2018	Circuit1756	559	29	570	386	685	533	865	694
2018	2018	Circuit940		76		76	0	0	0	0
2018	2018	Circuit941	1	106	126	78	61	18	7	29
2018	2018	Circuit942				#DIV/0!	9	0	0	3
2018	2018	Circuit943	94	2	353	150	2064	29	26	706
2018	2018	Circuit2932	80	53	157	97	573	507	1,212	764
2018	2018	Circuit2933	1384	1533	1467	1461	259	1,545	418	741
2018	2018	Circuit2934	475	91	2178	915	794	942	813	850
2018	2018	Circuit2935	100	177	128	135	1418	481	568	822
2018	2018	Circuit2936	10	9	50	23	74	153	92	106
2018	2018	Circuit2937	134	6	9	50	141	422	821	461
2018	2018	Circuit1250		8	14	11	4	4	10	6
2018	2018	Circuit1252	641	9	242	297	234	130	480	281
2018	2018	Circuit1253	2747	610	944	1434	1094	312	1,574	993
2018	2018	Circuit1255	2237	9	118	788	203	50	1,902	718
2018	2018	Circuit1256	3700	124	3033	2286	122	350	2,508	993
2018	2018	Circuit1257	174	145		160	143	138	19	100
2018	2018	Circuit944	390	436	17	281	103	1,317	1,539	986
2018	2018	Circuit945	7			7	3	10	40	18
2018	2018	Circuit946	4	220	215	146	705	1,699	1,587	1330
2018	2018	Circuit947		136	1	69	159	174	505	279
2018	2018	Circuit3649				#DIV/0!	0	0	0	0
2018	2018	Circuit1766	210	1147	485	614	26	17	520	188
2018	2018	Circuit1768	77	504	2	194	73	360	707	380
2018	2018	Circuit1769	742	1917	654	1104	44	17	2,554	872
2018	2018	Circuit1771				#DIV/0!	2	0	0	1
2018	2018	Circuit1772	97	848	606	517	492	128	391	337

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit1773	802	8	5609	2140	856	1,409	1,909	1391
2018	2018	Circuit1774	253	45	8017	2772	731	669	687	696
2018	2018	Circuit2971	1271	71	400	581	2375	1,252	190	1272
2018	2018	Circuit2973	4	40	188	77	1455	2,839	1,549	1948
2018	2018	Circuit948		6	13	10	0	0	0	0
2018	2018	Circuit950	104	417	862	461	415	311	114	280
2018	2018	Circuit951	1487	840	192	840	833	1,042	500	792
2018	2018	Circuit952	90	86	1417	531	157	192	171	173
2018	2018	Circuit953	284	593	1073	650	845	261	299	468
2018	2018	Circuit954	1061	823	2484	1456	1804	840	1,438	1361
2018	2018	Circuit955	411	710	1279	800	803	814	1,440	1019
2018	2018	Circuit4089	1			1	0	0	0	0
2018	2018	Circuit2993			13	13	2	4	0	2
2018	2018	Circuit2994	36	52	65	51	4	20	51	25
2018	2018	Circuit2995	94	906	1519	840	242	792	602	545
2018	2018	Circuit2996	57	764	738	520	1417	233	289	646
2018	2018	Circuit2997	15	498	714	409	32	93	492	206
2018	2018	Circuit2998	59	1144	1004	736	1413	191	475	693
2018	2018	Circuit2999	42	726	895	554	2856	836	422	1371
2018	2018	Circuit3737			1	1	0	0	0	0
2018	2018	Circuit957	309	2	97	136	1134	883	84	700
2018	2018	Circuit958	1078	466	658	734	1031	0	0	344
2018	2018	Circuit960	1722	98	5111	2310	4279	647	226	1717
2018	2018	Circuit3598		1		1	329	0	0	110
2018	2018	Circuit3041	544	54	3	200	129	15	1,450	531
2018	2018	Circuit3056	83	34	6	41	98	4	3	35
2018	2018	Circuit3064	799	1024	523	782	31	135	918	361
2018	2018	Circuit3065	1194	972	2374	1513	78	2,441	2,986	1835
2018	2018	Circuit3066	876	127	1637	880	335	955	1,624	971
2018	2018	Circuit3069				#DIV/0!	0	14	1	5
2018	2018	Circuit1779	82	1009	1487	859	42	911	1,523	825
2018	2018	Circuit3070	45	35	1070	383	61	1,078	673	604
2018	2018	Circuit3071	131	1289	647	689	2001	1,343	136	1160
2018	2018	Circuit3072	280	19	654	318	27	913	1,452	797
2018	2018	Circuit3073	1143	1183	323	883	437	561	902	633
2018	2018	Circuit3074	362	5	181	183	1363	928	136	809
2018	2018	Circuit1780	70	41	22	44	37	625	2,102	921
2018	2018	Circuit1782	33			33	13	5	69	29
2018	2018	Circuit1783	16			16	14	5	72	30
2018	2018	Circuit1785	2	2	36	13	7	4	172	61
2018	2018	Circuit1788		7		7	2	8	23	11
2018	2018	Circuit1789	766	139	194	366	1314	912	5,867	2698
2018	2018	Circuit1790	2247	728	1469	1481	801	50	4,008	1620
2018	2018	Circuit1791	687	10	19	239	78	348	1,716	714

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit1792	1564	307	1507	1126	392	1,305	7,538	3078
2018	2018	Circuit1793	106	120	59	95	12	185	1,478	558
2018	2018	Circuit1794	1645	844	1083	1191	1093	667	2,268	1343
2018	2018	Circuit1795	205	6		106	0	30	789	273
2018	2018	Circuit3657	4	81	56	47	0	0	0	0
2018	2018	Circuit3606	43	16	1	20	7	0	0	2
2018	2018	Circuit3607	2	6		4	0	0	0	0
2018	2018	Circuit3608	48	1		25	2	4	0	2
2018	2018	Circuit3609	10			10	9	2	0	4
2018	2018	Circuit3660				#DIV/0!	3	0	0	1
2018	2018	Circuit3713	1166			1166	0	0	0	0
2018	2018	Circuit3662				#DIV/0!	0	1	0	0
2018	2018	Circuit3663	2	2	2	2	0	0	0	0
2018	2018	Circuit3611	20	385	32	146	60	15	3	26
2018	2018	Circuit3714	641	1019	1	554		0	0	0
2018	2018	Circuit3096	5	478	1	161	16	14	81	37
2018	2018	Circuit3097	356	2276	418	1017	490	2,318	3,211	2006
2018	2018	Circuit3099	1121	2063	273	1152	1229	1,777	801	1269
2018	2018	Circuit3100	21	518	843	461	327	698	863	629
2018	2018	Circuit3101	128	135	3700	1321	1385	2,344	2,227	1985
2018	2018	Circuit3102	66	1045	91	401	823	1,809	103	912
2018	2018	Circuit1798	279	920	1687	962	2689	1,058	1,907	1885
2018	2018	Circuit1799	477	255	860	531	829	863	3,256	1649
2018	2018	Circuit1800	1505	56	258	606	651	253	1,912	939
2018	2018	Circuit1801	286	38	944	423	694	200	773	556
2018	2018	Circuit1802	2498	628	824	1317	1484	1,462	893	1280
2018	2018	Circuit1803	10	1	8	6	23	5	29	19
2018	2018	Circuit1804	1276	73	399	583	1624	149	1,947	1240
2018	2018	Circuit1805	2			2	8	4	31	14
2018	2018	Circuit1806	89	6	92	62	3	15	0	6
2018	2018	Circuit1807	1			1	2	2	0	1
2018	2018	Circuit1809	12	9	606	209	1154	49	285	496
2018	2018	Circuit3124	2	15		9	11	38	7	19
2018	2018	Circuit3126	1	3	10	5	7	3	2	4
2018	2018	Circuit3131	74	176	152	134	161	98	1,163	474
2018	2018	Circuit4090			1	1	0	0	0	0
2018	2018	Circuit1812	3	1	4	3	49	61	59	56
2018	2018	Circuit1815	3		2	3	19	12	3	11
2018	2018	Circuit1816				#DIV/0!	1	4	0	2
2018	2018	Circuit1817				#DIV/0!	0	2	1	1
2018	2018	Circuit1818	5	1	16	7	4	0	0	1
2018	2018	Circuit1819	2	21	5	9	46	12	40	33
2018	2018	Circuit1820	170	166	547	294	223	109	852	395
2018	2018	Circuit1821	1663	7	1624	1098	2880	4,664	22	2522

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit1822	7	46	92	48	162	9	39	70
2018	2018	Circuit1823	80	1533	11	541	1386	1,452	209	1016
2018	2018	Circuit1824	89	2365	82	845	1104	3,142	1,913	2053
2018	2018	Circuit1825	121	1592	3373	1695	1270	261	710	747
2018	2018	Circuit1826	7	2094	4	702	1316	37	81	478
2018	2018	Circuit3156				#DIV/0!	0	4	0	1
2018	2018	Circuit1265	4	3	4	4	53	0	0	18
2018	2018	Circuit1266				#DIV/0!	1	8	1	3
2018	2018	Circuit1268		1		1	0	3	0	1
2018	2018	Circuit1271	61	1	24	29	1	83	3	29
2018	2018	Circuit1272	23			23	16	1	1	6
2018	2018	Circuit1274	287	123	123	178	1376	3,429	162	1656
2018	2018	Circuit1275	821	793	1113	909	1044	155	1,767	989
2018	2018	Circuit1276	675	722	75	491	52	38	76	55
2018	2018	Circuit1827	277	4	3	95	33	517	1,254	601
2018	2018	Circuit1828	574	265	643	494	448	246	247	314
2018	2018	Circuit1829	632	239	238	370	313	524	417	418
2018	2018	Circuit1830	86	56	395	179	509	289	1,234	677
2018	2018	Circuit3184	9	3	19	10	16	23	12	17
2018	2018	Circuit3185	5225	1	39	1755	1425	3,640	5,019	3361
2018	2018	Circuit3186	734	11	1403	716	492	1,744	46	761
2018	2018	Circuit3187	37	749	853	546	44	139	1,021	401
2018	2018	Circuit3188	46	7	33	29	882	435	1,832	1050
2018	2018	Circuit3189		1763	133	948	0	0	0	0
2018	2018	Circuit3190	27	610	16	218	20	26	154	67
2018	2018	Circuit3192	37	59	241	112	306	1,212	2,669	1396
2018	2018	Circuit3193	7	369	166	181	842	426	380	549
2018	2018	Circuit3194	20	474	77	190	2132	1,773	1,137	1681
2018	2018	Circuit3195	1266	421	1680	1122	716	1,626	3,080	1807
2018	2018	Circuit1839	458	506	29	331	92	703	971	589
2018	2018	Circuit1845	9	106	434	183	802	52	625	493
2018	2018	Circuit1846	76	197	421	231	104	383	273	253
2018	2018	Circuit1847		0	53	27	0	236	13	83
2018	2018	Circuit1848	89	16	637	247	373	132	1,167	557
2018	2018	Circuit1849	17	56	337	137	835	23	29	296
2018	2018	Circuit1850			2	2	1	1	3	2
2018	2018	Circuit1851	41	78	514	211	246	479	187	304
2018	2018	Circuit1852	1	14	15	10	5	1	1	2
2018	2018	Circuit1853	3	4	6	4	311	188	410	303
2018	2018	Circuit1854	431	775	520	575	437	120	216	258
2018	2018	Circuit1433	462	154	1496	704	1176	604	570	783
2018	2018	Circuit1434	481	354	1721	852	1910	899	1,931	1580
2018	2018	Circuit1435	850	1483	619	984	1112	819	763	898
2018	2018	Circuit1436	413	636	268	439	408	256	398	354

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit2145	14	35	327	125	35	74	883	331
2018	2018	Circuit2146	124	609	3056	1263	142	989	2,271	1134
2018	2018	Circuit2147	5	41	445	164	60	356	1,739	718
2018	2018	Circuit1300	177	67	10	85	1220	2,281	47	1183
2018	2018	Circuit1301	756	1503	51	770	1261	1,405	169	945
2018	2018	Circuit1302	1485	43	16	515	72	1,032	1,097	734
2018	2018	Circuit4091	1			1	0	0	0	0
2018	2018	Circuit1303	31	17	1185	411	90	1,117	1,027	745
2018	2018	Circuit1295	1125	267	786	726	429	1,254	10	564
2018	2018	Circuit1297	2	21	423	149	915	474	0	463
2018	2018	Circuit1304	207	168	104	160	1733	196	322	750
2018	2018	Circuit1306	1588	13	642	748	1117	690	158	655
2018	2018	Circuit1298	434	34	42	170	750	330	127	402
2018	2018	Circuit3717	1			1	0	0	0	0
2018	2018	Circuit3735		16	2	9	0	0	0	0
2018	2018	Circuit975	2	1		2	2	21	73	32
2018	2018	Circuit978	84		1	43	32	68	161	87
2018	2018	Circuit3677		1		1	0	0	0	0
2018	2018	Circuit982			1	1	0	0	2	1
2018	2018	Circuit986			1	1	4	7	16	9
2018	2018	Circuit987	159	4	396	186	734	21	915	557
2018	2018	Circuit988	329	310	1025	555	221	166	727	371
2018	2018	Circuit989	499	287	808	531	628	593	3,842	1688
2018	2018	Circuit991	71	39	598	236	640	352	1,901	964
2018	2018	Circuit992	96	26	158	93	222	34	420	225
2018	2018	Circuit994	860	3459	2292	2204	2610	2,339	8,230	4393
2018	2018	Circuit995	607	3924	3392	2641	5160	772	3,271	3068
2018	2018	Circuit1878	950	131	149	410	442	506	160	369
2018	2018	Circuit1879	105			105	34	11	8	18
2018	2018	Circuit1880	503	59	819	460	1737	974	6,735	3149
2018	2018	Circuit2150	1052	1541	2764	1786	2162	3,408	2,689	2753
2018	2018	Circuit3721	1			1	0	0	0	0
2018	2018	Circuit3314	1	30	23	18	0	2	0	1
2018	2018	Circuit3316	6	9	33	16	18	106	56	60
2018	2018	Circuit3317	502	564	41	369	501	415	509	475
2018	2018	Circuit3318	682	79	402	388	23	34	11	23
2018	2018	Circuit3319	11	606	16	211	699	101	202	334
2018	2018	Circuit3320	29	32	62	41	123	97	176	132
2018	2018	Circuit3321	22	60	986	356	95	132	408	212
2018	2018	Circuit3322	18	17	7	14	10	13	65	29
2018	2018	Circuit3323	14	8	343	122	13	635	113	254
2018	2018	Circuit3324	7	58	5	23	750	857	36	548
2018	2018	Circuit1455				#DIV/0!	2	3	0	2
2018	2018	Circuit2167	1003	90	1830	974	94	79	200	124

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit2165	4	550	647	400	1458	502	616	859
2018	2018	Circuit2166	441	150	1295	629	1140	238	1,240	873
2018	2018	Circuit1307		1		1	1	6	0	2
2018	2018	Circuit1308	3	10	2	5	14	4	0	6
2018	2018	Circuit1309	1		4	3	8	62	5	25
2018	2018	Circuit1310				#DIV/0!	1	0	1	1
2018	2018	Circuit1311			3	3	3	55	57	38
2018	2018	Circuit1312				#DIV/0!	0	0	40	13
2018	2018	Circuit1313	31	11	115	52	350	567	41	319
2018	2018	Circuit3395	342	880	866	696	2466	974	3,077	2172
2018	2018	Circuit3397	101	3	111	72	582	626	89	432
2018	2018	Circuit3398	50	55	226	110	97	615	133	282
2018	2018	Circuit3399			72	72	3	3	4	3
2018	2018	Circuit3400	15	1070	832	639	860	3,166	1,188	1738
2018	2018	Circuit1458	13	652	1918	861	1881	50	292	741
2018	2018	Circuit1459	26	1428	2051	1168	1417	174	49	547
2018	2018	Circuit1460	166	2113	2936	1738	2199	111	91	800
2018	2018	Circuit1461				#DIV/0!	2	0	0	1
2018	2018	Circuit1462	2	264	338	201	350	64	170	195
2018	2018	Circuit1463	409	794	798	667	832	43	86	320
2018	2018	Circuit1464	731	158	729	539	1121	86	531	579
2018	2018	Circuit3724	1			1	0	0	0	0
2018	2018	Circuit1907	4	1		3	2	1	1	1
2018	2018	Circuit1908	222	1		112	258	141	0	133
2018	2018	Circuit1910	1951	52	1618	1207	1845	728	45	873
2018	2018	Circuit1912	9106	1597	176	3626	5234	1,362	3,222	3273
2018	2018	Circuit1916	1	13		7	0	27	0	9
2018	2018	Circuit1917	1			1	0	0	0	0
2018	2018	Circuit1918	7	672	41	240	86	1,318	58	487
2018	2018	Circuit1919	1	488	4	164	1802	10	131	648
2018	2018	Circuit1920		30	1181	606	0	0	0	0
2018	2018	Circuit1921	2294	324	1319	1312	1649	1,500	1,035	1395
2018	2018	Circuit1922	4778	109	1233	2040	2457	3,602	975	2345
2018	2018	Circuit1923			4	4	0	0	0	0
2018	2018	Circuit1924	161	1338	408	636	2196	393	95	895
2018	2018	Circuit1925	28	1793	2514	1445	1754	1,719	838	1437
2018	2018	Circuit1926	13	796	501	437	22	19	6	16
2018	2018	Circuit1009	1514	1	8	508	117	869	887	624
2018	2018	Circuit1010	730	51	824	535	2361	547	1,340	1416
2018	2018	Circuit1011	18	8	9	12	20	348	508	292
2018	2018	Circuit1012	775	3	701	493	853	316	955	708
2018	2018	Circuit1013	4	6	1146	385	526	670	271	489
2018	2018	Circuit1014	10	8	694	237	1417	659	1,355	1144
2018	2018	Circuit1016	49	1189	747	662	684	1,424	1,691	1266

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Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit1017	31	17	582	210	41	1,183	1,830	1018
2018	2018	Circuit1018	3	4	26	11	560	444	200	401
2018	2018	Circuit1019	89	43	2535	889	607	1,099	75	594
2018	2018	Circuit1022	17	51	1632	567	149	2,022	989	1053
2018	2018	Circuit1023	717	4	764	495	495	336	331	387
2018	2018	Circuit3732		145		145	0	0	0	0
2018	2018	Circuit1927	163	22	31	72	53	11	20	28
2018	2018	Circuit1928	408	10	38	152	18	525	206	250
2018	2018	Circuit1936		3	1	2	2	0	4	2
2018	2018	Circuit1938		3		3	0	0	4	1
2018	2018	Circuit1939	19	65	816	300	1120	191	511	607
2018	2018	Circuit1940	1211	228	3858	1766	1168	531	815	838
2018	2018	Circuit1941	539	143	208	297	921	1,954	1,421	1432
2018	2018	Circuit1024	15	31	163	70	56	11	38	35
2018	2018	Circuit1026	32	1	3	12	12	5	258	92
2018	2018	Circuit1028		74	2	38	174	1	176	117
2018	2018	Circuit1029	1	4	16	7	4	11	39	18
2018	2018	Circuit1030	2	1		2	2	1	264	89
2018	2018	Circuit1031				#DIV/0!	0	0	1	0
2018	2018	Circuit1032	14	3	1	6	1	105	1	36
2018	2018	Circuit1033	120	2	1	41	33	0	3	12
2018	2018	Circuit1034	3		1	2	19	0	6	8
2018	2018	Circuit3725	1			1	0	0	0	0
2018	2018	Circuit3726	1			1	0	0	0	0
2018	2018	Circuit1038	181	81	342	201	561	222	276	353
2018	2018	Circuit1037	114	7	16	46	0	0	0	0
2018	2018	Circuit3729		982	20	501	0	0	0	0
2018	2018	Circuit3484	137	81	90	103	1	65	41	36
2018	2018	Circuit3722	2	1		2	0	0	0	0
2018	2018	Circuit3486	37	53	84	58	3	0	20	8
2018	2018	Circuit3487	8	84	6	33	44	4	70	39
2018	2018	Circuit3488		44	1	23	8	11	8	9
2018	2018	Circuit3489				#DIV/0!	238	1,285	2,303	1275
2018	2018	Circuit3490		802	59	431	178	628	2,184	997
2018	2018	Circuit3690	175	7	2	61	0	0	0	0
2018	2018	Circuit3491	448	1085	219	584	1526	421	759	902
2018	2018	Circuit3492	3	854	972	610	545	40	275	287
2018	2018	Circuit3493	164	2040	932	1045	785	1,173	597	852
2018	2018	Circuit3495	17	24	219	87	107	763	1,061	644
2018	2018	Circuit3496	700	639	69	469	671	30	897	533
2018	2018	Circuit3497	788	76	139	334	565	276	1,589	810
2018	2018	Circuit3498	21	95	1011	376	119	1,457	534	703
2018	2018	Circuit3499	110	1215	2041	1122	86	167	255	169
2018	2018	Circuit3501	238	124	2206	856	120	498	2,858	1159

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2018	2018	Circuit3502	1741	1647	4974	2787	2412	2,093	2,116	2207
2018	2018	Circuit3503	54	33	53	47	79	418	472	323
2018	2018	Circuit3509	22	11	738	257	1399	81	663	714
2018	2018	Circuit3510	1283	1127	67	826	189	280	1,700	723
2018	2018	Circuit3511	16	64	9	30	35	761	1,624	807
2018	2018	Circuit3513	12	2		7	31	8	155	65
2018	2018	Circuit3723	1			1	0	0	0	0
2018	2018	Circuit3535		6		6	0	0	0	0
2018	2018	Circuit3686	46	14	1	20	0	0	0	0
2018	2018	Circuit3536				#DIV/0!	0	0	1	0
2018	2018	Circuit3537	2		7	5	43	11	8	21
2018	2018	Circuit3688				#DIV/0!	0	0	0	0
2018	2018	Circuit3619	16	71	257	115	2140	0	0	713
2018	2018	Circuit3621	23	1270	1611	968	2885	0	0	962
2018	2018	Circuit1047	554	63	53	223	1274	128	74	492
2018	2018	Circuit1048	322	97	984	468	114	281	355	250
2018	2018	Circuit2376				#DIV/0!		1,452	320	886
2018	2018	Circuit1049	2730	70	305	1035	51	1,319	151	507
2018	2018	Circuit2377				#DIV/0!	9	2,500	441	983
2018	2018	Circuit2378				#DIV/0!	17	1,001	438	485
2019	2019	Circuit3715	2	1		2		0	0	0
2019	2019	Circuit3720		1		1		0	0	0
2019	2019	Circuit206	7	832	96	312	517	19	564	367
2019	2019	Circuit208	32	259	15	102	798	51	19	289
2019	2019	Circuit211	160	246	210	205	2822	122	1,484	1476
2019	2019	Circuit2434	7	13	38	19	124	28	356	169
2019	2019	Circuit2436	211	1768	828	936	177	860	836	624
2019	2019	Circuit2438	1	131	2	45	20	7	23	17
2019	2019	Circuit2439	8	1987	719	905	210	901	77	396
2019	2019	Circuit3624		1		1		0	0	0
2019	2019	Circuit2441	1			1	3	1	9	4
2019	2019	Circuit2442	961	294	1230	828	1184	1,503	1,214	1300
2019	2019	Circuit2443	44	672	108	275	258	111	789	386
2019	2019	Circuit2444	820	723	322	622	63	1,494	830	796
2019	2019	Circuit2445	13	628	15	219	28	566	715	436
2019	2019	Circuit2446	626	46	654	442	45	878	147	357
2019	2019	Circuit2447	66	14	76	52	1135	423	2,320	1293
2019	2019	Circuit2455	2	2	5	3	42	2	3	16
2019	2019	Circuit2460	1	1	3	2	25	297	870	397
2019	2019	Circuit2466		3		3	1	0	3	1
2019	2019	Circuit2472	1	37	35	24	16	133	345	165
2019	2019	Circuit2473	192	570	13	258	1015	864	621	833
2019	2019	Circuit2474	7	22	236	88	658	8	28	231
2019	2019	Circuit1595		1		1		0	0	0

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit1596		18	42	30	34	4	43	27
2019	2019	Circuit1597	4	194	110	103	86	75	102	88
2019	2019	Circuit1598	264	787	2779	1277	1176	818	2,059	1351
2019	2019	Circuit1599	16	688	71	258	322	896	522	580
2019	2019	Circuit1600	88	263	881	411	283	1,483	1,242	1003
2019	2019	Circuit1601	314	2589	1021	1308	1243	1,497	344	1028
2019	2019	Circuit1602	14	59	154	76	66	432	1,241	580
2019	2019	Circuit1603	41	115	1289	482	560	14	828	467
2019	2019	Circuit1604	965	39	1694	899	657	201	292	383
2019	2019	Circuit1605	123	195	1934	751	1194	1,153	1,425	1257
2019	2019	Circuit1606	671	428	3885	1661	1222	761	1,974	1319
2019	2019	Circuit1607	104	2002	806	971	186	420	1,074	560
2019	2019	Circuit3741		11		11		0	0	0
2019	2019	Circuit2015		170	3	87	426	84	0	170
2019	2019	Circuit2016	7	1933	716	885	2915	349	105	1123
2019	2019	Circuit2017	28	883	1369	760	3256	144	165	1188
2019	2019	Circuit2019	3	23	8	11	58	43	4	35
2019	2019	Circuit2020	173	186	8	122	216	354	121	230
2019	2019	Circuit2021	184			184		0	0	0
2019	2019	Circuit2022	155	1621	902	893	1273	973	1,088	1111
2019	2019	Circuit2023	75	1128	88	430	1801	1,508	597	1302
2019	2019	Circuit2024	299	1318	88	568	678	647	70	465
2019	2019	Circuit2025	51	1318	894	754	654	1,019	449	707
2019	2019	Circuit3728	37			37		0	0	0
2019	2019	Circuit1629	63	28	106	66	185	458	1,837	827
2019	2019	Circuit1630	70	1840	1023	978	191	887	54	377
2019	2019	Circuit1631	151	108	675	311	89	1,312	621	674
2019	2019	Circuit1632	111	92	645	283	186	1,173	230	530
2019	2019	Circuit1633	867	2019	1470	1452	90	2,252	912	1085
2019	2019	Circuit2559	4	251	1331	529	399	671	234	435
2019	2019	Circuit1634	513	193	297	334	326	603	242	390
2019	2019	Circuit2566	220	174	690	361	441	283	318	347
2019	2019	Circuit2578	703	1531	1300	1178	2310	2,166	279	1585
2019	2019	Circuit2579	171	82	172	142	1560	2,051	189	1267
2019	2019	Circuit3730	1			1		0	0	0
2019	2019	Circuit1237	138	4	195	112	320	89	337	249
2019	2019	Circuit1238	1			1		0	0	0
2019	2019	Circuit1239	8	27	315	117	514	193	45	251
2019	2019	Circuit1240	523	138	278	313	480	1	37	173
2019	2019	Circuit1242	376	70	383	276	947	67	5	340
2019	2019	Circuit1243	304	441	543	429	893	415	96	468
2019	2019	Circuit1244	668	5	109	261	618	116	1,566	767
2019	2019	Circuit1245	9	180	39	76	621	199	26	282
2019	2019	Circuit1246	55	625	400	360	582	39	282	301

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit3710				#DIV/0!		0	0	0
2019	2019	Circuit820		24	12	18	20	0	18	13
2019	2019	Circuit825		6	1	4		6	1	4
2019	2019	Circuit826	61	90	12	54	17	27	17	20
2019	2019	Circuit827	1	187	22	70	136	5	108	83
2019	2019	Circuit828	1356	2352	1796	1835	3413	541	516	1490
2019	2019	Circuit829	123	3840	3219	2394	3919	309	485	1571
2019	2019	Circuit830	530	969	628	709	2165	347	1,030	1181
2019	2019	Circuit831	2	29	32	21	35	5	14	18
2019	2019	Circuit832	791	1843	499	1044	2067	908	1,156	1377
2019	2019	Circuit833	179	660	76	305	2326	44	642	1004
2019	2019	Circuit834	24	463	401	296	671	752	271	565
2019	2019	Circuit835	78	2443	2031	1517	1022	1,095	2,491	1536
2019	2019	Circuit836	65	1303	1377	915	756	210	960	642
2019	2019	Circuit837	5	212	18	78	4	245	515	255
2019	2019	Circuit838	462	2292	1386	1380	2205	411	1,444	1353
2019	2019	Circuit3578	37	624		331		0	0	0
2019	2019	Circuit2679				#DIV/0!	3	14	26	14
2019	2019	Circuit2681				#DIV/0!	978	217	739	645
2019	2019	Circuit3736		2342		2342		0	0	0
2019	2019	Circuit3733	1			1		0	0	0
2019	2019	Circuit1663	743	312	896	650	302	911	328	514
2019	2019	Circuit1664	45	842	1946	944	38	885	201	375
2019	2019	Circuit1665	523	585	1063	724	1714	703	131	849
2019	2019	Circuit1666	4036	6334	198	3523	4268	1,339	465	2024
2019	2019	Circuit1668	192	329	855	459	216	1,614	1,575	1135
2019	2019	Circuit1669	1046	269	859	725	5228	1,132	227	2196
2019	2019	Circuit852	3	748	535	429	793	614	93	500
2019	2019	Circuit853	32	276	552	287	44	64	53	54
2019	2019	Circuit854	92	515	1223	610	2528	1,254	1,987	1923
2019	2019	Circuit856		26		26	1	0	0	0
2019	2019	Circuit858	53	43	94	63	13	0	115	43
2019	2019	Circuit859	319	355	845	506	188	390	410	329
2019	2019	Circuit3743		1		1		0	0	0
2019	2019	Circuit861	175	762	2299	1079	1973	145	541	886
2019	2019	Circuit862	541	267	151	320	102	147	1,263	504
2019	2019	Circuit863	43	792	1594	810	219	2,197	986	1134
2019	2019	Circuit864	35	8	236	93	51	40	302	131
2019	2019	Circuit3742		1		1		0	0	0
2019	2019	Circuit3739		1		1		0	0	0
2019	2019	Circuit3711				#DIV/0!		0	0	0
2019	2019	Circuit1684	37	524	573	378	508	599	24	377
2019	2019	Circuit1685	6	2198	128	777	64	1,186	14	421
2019	2019	Circuit1686	442	1307	26	592	107	1,512	132	584

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit1687	58	794	78	310	58	957	104	373
2019	2019	Circuit1688	140	1457	1434	1010	1602	111	62	592
2019	2019	Circuit2729		1		1	1	0	2	1
2019	2019	Circuit2730			5	5	5	0	0	2
2019	2019	Circuit2732			3	3	3	0	1	1
2019	2019	Circuit2733	1		52	27	2	57	5	21
2019	2019	Circuit2734	141	413	695	416	27	750	563	447
2019	2019	Circuit2737	71	1302	2210	1194	1793	97	2,542	1477
2019	2019	Circuit2738	3	364	377	248	35	275	49	120
2019	2019	Circuit2739	214	1070	1048	777	1013	477	984	825
2019	2019	Circuit2740	32	1838	2495	1455	87	1,326	60	491
2019	2019	Circuit2741	41	819	201	354	807	1,351	1,279	1146
2019	2019	Circuit2742	41	1585	2306	1311	5791	353	1,492	2545
2019	2019	Circuit2744	24	943	928	632	113	1,001	406	507
2019	2019	Circuit2745	42	36	829	302	26	81	405	171
2019	2019	Circuit2746	134	71	2935	1047	461	328	1,239	676
2019	2019	Circuit2752	84	101	1230	472	458	120	1,233	604
2019	2019	Circuit2753	54	11	83	49	79	245	56	127
2019	2019	Circuit2754	46	499	188	244	247	113	93	151
2019	2019	Circuit2755	17	115	91	74	61	143	20	75
2019	2019	Circuit2756	4	53	342	133	56	27	42	42
2019	2019	Circuit4087	1			1		0	0	0
2019	2019	Circuit875	377	886	1520	928	766	2,581	727	1358
2019	2019	Circuit876	1174	1278	63	838	1310	1,332	1,393	1345
2019	2019	Circuit3712				#DIV/0!		0	0	0
2019	2019	Circuit3716		1		1		0	0	0
2019	2019	Circuit3587	755	1014	1478	1082	10	0	0	3
2019	2019	Circuit1701	2899	2611	2982	2831		0	0	0
2019	2019	Circuit3588	397	743	233	458		0	0	0
2019	2019	Circuit2060	1880	263	1700	1281	171	22	68	87
2019	2019	Circuit4088		1		1		0	0	0
2019	2019	Circuit2790	57	1281	426	588	383	1,075	988	815
2019	2019	Circuit2791	507	263	211	327	407	613	243	421
2019	2019	Circuit2792	170	2264	900	1111	819	2,728	795	1447
2019	2019	Circuit2794	426	856	993	758	208	893	1,101	734
2019	2019	Circuit2807	1448	8	752	736	788	20	31	280
2019	2019	Circuit2808	42	696	59	266	112	1,199	282	531
2019	2019	Circuit879	2	2	2	2	4	11	5	7
2019	2019	Circuit880	7			7		1	0	1
2019	2019	Circuit882	4	7	4	5		0	18	9
2019	2019	Circuit883			1	1	3	2	131	45
2019	2019	Circuit884	2	2		2		2	9	6
2019	2019	Circuit886	1	36	5	14	12	1	2	5
2019	2019	Circuit887	21	66	542	210	925	841	767	844

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit888	111	1159	10	427	286	610	177	358
2019	2019	Circuit889	825	885	1589	1100	1847	2,056	2,067	1990
2019	2019	Circuit892	15	710	174	300	768	832	741	780
2019	2019	Circuit893	92	334	107	178	38	175	100	104
2019	2019	Circuit2063	335	1275	90	567	2604	218	228	1017
2019	2019	Circuit3718				#DIV/0!		0	0	0
2019	2019	Circuit2067		53	216	135	26	435	19	160
2019	2019	Circuit2068	171	693	1234	699	1390	2,783	202	1458
2019	2019	Circuit2069	72	199	2289	853	346	3,683	112	1380
2019	2019	Circuit2070	40	270	776	362	543	2,218	2,225	1662
2019	2019	Circuit2071	60	190	998	416	468	1,260	93	607
2019	2019	Circuit2072	28	481	989	499	538	920	80	513
2019	2019	Circuit3740		1		1		0	0	0
2019	2019	Circuit895		1		1	4	1	0	2
2019	2019	Circuit3622				#DIV/0!		0	0	0
2019	2019	Circuit3643				#DIV/0!		1	0	1
2019	2019	Circuit896				#DIV/0!	1	0	0	0
2019	2019	Circuit3623	121	207		164		0	0	0
2019	2019	Circuit897	4	153	163	107	23	1	1	8
2019	2019	Circuit901	2	136	41	60	5	88	7	33
2019	2019	Circuit903	38	66	49	51	186	132	21	113
2019	2019	Circuit904	380	100	1285	588	186	940	889	672
2019	2019	Circuit3734	35	4		20		0	0	0
2019	2019	Circuit1708	1630	1169	224	1008	1313	155	2,137	1202
2019	2019	Circuit1709	720	865	49	545	653	151	1,783	862
2019	2019	Circuit1712	711	362	204	426	35	474	26	178
2019	2019	Circuit2083	550	934	122	535	2400	55	133	863
2019	2019	Circuit2084	1551	604	31	729	2303	1,716	26	1348
2019	2019	Circuit2085	2595	99	1740	1478	2411	96	41	849
2019	2019	Circuit2086	91	2069		1080		0	0	0
2019	2019	Circuit3731	1			1		0	0	0
2019	2019	Circuit2087	32	31	58	40	1596	3,006	720	1774
2019	2019	Circuit2088	849	1149	4061	2020	2843	5,074	137	2685
2019	2019	Circuit1717	1	1	9	4		0	3	2
2019	2019	Circuit1719				#DIV/0!		1	1	1
2019	2019	Circuit1721			3	3		0	0	0
2019	2019	Circuit1727	36	5	20	20	48	1	0	16
2019	2019	Circuit1728	11	6	17	11	180	209	27	139
2019	2019	Circuit1729	5		4	5	1	5	1	2
2019	2019	Circuit1730	2	19	2	8	4	11	5	7
2019	2019	Circuit1732	1552	1131	71	918	514	281	380	392
2019	2019	Circuit1733	981	1811	1130	1307	1141	1,107	825	1024
2019	2019	Circuit1734	913	1773	3074	1920	2025	1,104	224	1118
2019	2019	Circuit1735	732	1342	5416	2497	1143	1,845	598	1195

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit1736	27	1019	1576	874	787	1,267	523	859
2019	2019	Circuit1737	88	175	581	281	164	1,044	133	447
2019	2019	Circuit1738	637	1159	4546	2114	1274	3,202	372	1616
2019	2019	Circuit1739	24	258	1661	648	94	1,341	645	693
2019	2019	Circuit2859	1677	406	801	961	64	61	687	271
2019	2019	Circuit1401	33	394	386	271	120	892	16	343
2019	2019	Circuit1402	799	171	1429	800	401	1,448	107	652
2019	2019	Circuit3738		1		1		0	0	0
2019	2019	Circuit2862		3		3	2	21	1	8
2019	2019	Circuit2863	24	33	2	20	5	31	25	20
2019	2019	Circuit2864	153	42	370	188	26	270	43	113
2019	2019	Circuit2865	75	772	1731	859	904	180	799	628
2019	2019	Circuit2866	221	123	985	443	368	439	303	370
2019	2019	Circuit2869	584	652	646	627	35	684	595	438
2019	2019	Circuit2870	1031	1419	1463	1304	636	1,512	1,524	1224
2019	2019	Circuit2877	107	857	932	632	1147	2,167	287	1200
2019	2019	Circuit2878		2863		2863		0	0	0
2019	2019	Circuit2879	362	740	19	374	611	581	255	482
2019	2019	Circuit2881	401	332	340	358	1344	1,415	1,309	1356
2019	2019	Circuit2882	68	57	326	150	340	317	101	253
2019	2019	Circuit2884	1805	2	987	931	283	110	1,428	607
2019	2019	Circuit2885	134	202	496	277	1948	3,826	1,413	2396
2019	2019	Circuit2886	735	820	901	819	40	742	58	280
2019	2019	Circuit2887	67	570	419	352	1391	1,136	1,037	1188
2019	2019	Circuit2888	31	17	29	26	2123	1,648	44	1272
2019	2019	Circuit2889	1296	10	30	445	142	1,634	1,315	1030
2019	2019	Circuit2890	761	136	210	369	164	772	532	489
2019	2019	Circuit2895	26	66	1505	532	135	1,084	643	621
2019	2019	Circuit3727	1			1		0	0	0
2019	2019	Circuit3719				#DIV/0!		0	0	0
2019	2019	Circuit3590		5	30	18		0	0	0
2019	2019	Circuit3591	38	16	47	34		0	0	0
2019	2019	Circuit3592	3011	60	1620	1564		0	0	0
2019	2019	Circuit3594	743	7		375		0	0	0
2019	2019	Circuit3595	477	1091	1020	863		0	0	0
2019	2019	Circuit1752	17	637	176	277	28	466	361	285
2019	2019	Circuit1753	23	98	72	64	104	179	570	284
2019	2019	Circuit1759	661	1147	710	839	1270	762	835	956
2019	2019	Circuit1754	86	184	106	125	473	1,456	596	842
2019	2019	Circuit1755	2	431	444	292	19	760	829	536
2019	2019	Circuit1756	29	570	1147	582	533	865	1,638	1012
2019	2019	Circuit2932	53	157	850	353	507	1,212	335	685
2019	2019	Circuit2933	1533	1467	578	1193	1545	418	276	746
2019	2019	Circuit2934	91	2178	1153	1141	942	813	509	755

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		All Weather CI Control Group								
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit2935	177	128	1252	519	481	568	1,354	801
2019	2019	Circuit2936	9	50	310	123	153	92	130	125
2019	2019	Circuit2937	6	9	729	248	422	821	58	434
2019	2019	Circuit1250	8	14	9	10	4	10	10	8
2019	2019	Circuit1252	9	242	151	134	130	480	434	348
2019	2019	Circuit1253	610	944	654	736	312	1,574	936	941
2019	2019	Circuit1255	9	118	100	76	50	1,902	2,257	1403
2019	2019	Circuit1256	124	3033	1751	1636	350	2,508	1,343	1400
2019	2019	Circuit1257	145		37	91	138	19	18	58
2019	2019	Circuit944	436	17	37	163	1317	1,539	371	1076
2019	2019	Circuit945			2	2	10	40	1	17
2019	2019	Circuit946	220	215	23	153	1699	1,587	1,169	1485
2019	2019	Circuit947	136	1	9	49	174	505	210	296
2019	2019	Circuit3649			1	1		0	0	0
2019	2019	Circuit1766	1147	485	215	616	17	520	858	465
2019	2019	Circuit1768	504	2	27	178	360	707	229	432
2019	2019	Circuit1769	1917	654	18	863	17	2,554	1,189	1253
2019	2019	Circuit1771				#DIV/0!		0	0	0
2019	2019	Circuit1772	848	606	493	649	128	391	409	309
2019	2019	Circuit1773	8	5609	1176	2264	1409	1,909	576	1298
2019	2019	Circuit1774	45	8017	652	2905	669	687	57	471
2019	2019	Circuit948	6	13		10		0	0	0
2019	2019	Circuit950	417	862	509	596	311	114	326	250
2019	2019	Circuit951	840	192	838	623	1042	500	132	558
2019	2019	Circuit952	86	1417	1934	1146	192	171	593	319
2019	2019	Circuit953	593	1073	1048	905	261	299	213	258
2019	2019	Circuit954	823	2484	1408	1572	840	1,438	83	787
2019	2019	Circuit955	710	1279	1256	1082	814	1,440	1,021	1092
2019	2019	Circuit4089				#DIV/0!		0	0	0
2019	2019	Circuit2993		13	2	8	4	0	3	2
2019	2019	Circuit2994	52	65	1	39	20	51	19	30
2019	2019	Circuit2995	906	1519	189	871	792	602	1,151	848
2019	2019	Circuit2996	764	738	188	563	233	289	96	206
2019	2019	Circuit2997	498	714	46	419	93	492	80	222
2019	2019	Circuit2998	1144	1004	2072	1407	191	475	846	504
2019	2019	Circuit2999	726	895	1780	1134	836	422	179	479
2019	2019	Circuit3737		1		1		0	0	0
2019	2019	Circuit3598	1			1		0	0	0
2019	2019	Circuit3041	54	3	666	241	15	1,450	237	567
2019	2019	Circuit3056	34	6	160	67	4	3	122	43
2019	2019	Circuit3064	1024	523	459	669	135	918	423	492
2019	2019	Circuit3065	972	2374	1489	1612	2441	2,986	1,618	2348
2019	2019	Circuit3066	127	1637	3319	1694	955	1,624	1,432	1337
2019	2019	Circuit3069			6	6	14	1	0	5

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Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit1779	1009	1487	1559	1352	911	1,523	36	823
2019	2019	Circuit3070	35	1070	1361	822	1078	673	87	613
2019	2019	Circuit3071	1289	647	87	674	1343	136	24	501
2019	2019	Circuit3072	19	654	755	476	913	1,452	471	945
2019	2019	Circuit3073	1183	323	814	773	561	902	1,102	855
2019	2019	Circuit3074	5	181	1720	635	928	136	944	669
2019	2019	Circuit1780	41	22	2	22	625	2,102	172	966
2019	2019	Circuit1782			4	4	5	69	11	28
2019	2019	Circuit1783			16	16	5	72	14	30
2019	2019	Circuit1785	2	36	2	13	4	172	16	64
2019	2019	Circuit1788	7			7	8	23	13	15
2019	2019	Circuit1789	139	194	744	359	912	5,867	1,007	2595
2019	2019	Circuit1790	728	1469	1803	1333	50	4,008	212	1423
2019	2019	Circuit1791	10	19	948	326	348	1,716	4,084	2049
2019	2019	Circuit1792	307	1507	291	702	1305	7,538	486	3110
2019	2019	Circuit1793	120	59	30	70	185	1,478	2,725	1463
2019	2019	Circuit1794	844	1083	932	953	667	2,268	1,581	1505
2019	2019	Circuit1795	6		77	42	30	789	1,825	881
2019	2019	Circuit3657	81	56		69		0	0	0
2019	2019	Circuit3606	16	1	3	7		0	0	0
2019	2019	Circuit3607	6			6		0	0	0
2019	2019	Circuit3608	1		2	2	4	0	0	1
2019	2019	Circuit3609			1	1	2	0	10	4
2019	2019	Circuit3660				#DIV/0!		0	0	0
2019	2019	Circuit3713				#DIV/0!		0	0	0
2019	2019	Circuit3662				#DIV/0!	1	0	0	0
2019	2019	Circuit3663	2	2		2		0	0	0
2019	2019	Circuit3611	385	32	81	166	15	3	2	7
2019	2019	Circuit3714	1019	1		510		0	0	0
2019	2019	Circuit3096	478	1		240	14	81	6	34
2019	2019	Circuit3097	2276	418	241	978	2318	3,211	1,686	2405
2019	2019	Circuit3099	2063	273	79	805	1777	801	1,814	1464
2019	2019	Circuit3100	518	843	799	720	698	863	1,235	932
2019	2019	Circuit3101	135	3700	1353	1729	2344	2,227	1,800	2124
2019	2019	Circuit3102	1045	91	142	426	1809	103	1,115	1009
2019	2019	Circuit1798	920	1687	1215	1274	1058	1,907	1,343	1436
2019	2019	Circuit1799	255	860	2710	1275	863	3,256	656	1592
2019	2019	Circuit1800	56	258	424	246	253	1,912	1,401	1189
2019	2019	Circuit1801	38	944	1340	774	200	773	1,084	686
2019	2019	Circuit1802	628	824	2132	1195	1462	893	241	865
2019	2019	Circuit1803	1	8	1	3	5	29	28	21
2019	2019	Circuit1804	73	399	521	331	149	1,947	609	902
2019	2019	Circuit1805				#DIV/0!	4	31	0	12
2019	2019	Circuit3124	15		4	10	38	7	27	24

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit3126	3	10	26	13	3	2	5	3
2019	2019	Circuit3131	176	152	230	186	98	1,163	1,085	782
2019	2019	Circuit4090		1		1		0	0	0
2019	2019	Circuit1812	1	4	5	3	61	59	133	84
2019	2019	Circuit1815		2	22	12	12	3	2	6
2019	2019	Circuit1816				#DIV/0!	4	0	2	2
2019	2019	Circuit1817				#DIV/0!	2	1	2	2
2019	2019	Circuit1818	1	16	6	8		0	2	1
2019	2019	Circuit1819	21	5	52	26	12	40	5	19
2019	2019	Circuit1820	166	547	79	264	109	852	323	428
2019	2019	Circuit1821	7	1624	2312	1314	4664	22	933	1873
2019	2019	Circuit1822	46	92	24	54	9	39	12	20
2019	2019	Circuit1823	1533	11	1331	958	1452	209	52	571
2019	2019	Circuit1824	2365	82	271	906	3142	1,913	2,944	2666
2019	2019	Circuit1825	1592	3373	1470	2145	261	710	2,357	1109
2019	2019	Circuit1826	2094	4	827	975	37	81	897	338
2019	2019	Circuit3156				#DIV/0!	4	0	0	1
2019	2019	Circuit1827	4	3	32	13	517	1,254	78	616
2019	2019	Circuit1828	265	643	396	435	246	247	11	168
2019	2019	Circuit1829	239	238	162	213	524	417	557	499
2019	2019	Circuit1830	56	395	65	172	289	1,234	204	576
2019	2019	Circuit3184	3	19	3	8	23	12	7	14
2019	2019	Circuit3185	1	39	1850	630	3640	5,019	3,618	4092
2019	2019	Circuit3186	11	1403	742	719	1744	46	838	876
2019	2019	Circuit3187	749	853	71	558	139	1,021	129	430
2019	2019	Circuit3188	7	33	802	281	435	1,832	632	966
2019	2019	Circuit3189	1763	133		948		0	0	0
2019	2019	Circuit3190	610	16	20	215	26	154	115	98
2019	2019	Circuit3192	59	241	1189	496	1212	2,669	995	1625
2019	2019	Circuit3193	369	166	338	291	426	380	87	298
2019	2019	Circuit3194	474	77	1066	539	1773	1,137	1,210	1373
2019	2019	Circuit3195	421	1680	1331	1144	1626	3,080	3,142	2616
2019	2019	Circuit1839	506	29	124	220	703	971	94	589
2019	2019	Circuit1845	106	434	846	462	52	625	59	245
2019	2019	Circuit1846	197	421	456	358	383	273	47	234
2019	2019	Circuit1847	0	53		27	236	13	584	278
2019	2019	Circuit1848	16	637	769	474	132	1,167	60	453
2019	2019	Circuit1849	56	337	75	156	23	29	273	108
2019	2019	Circuit1850		2	5	4	1	3	0	1
2019	2019	Circuit1851	78	514	195	262	479	187	259	308
2019	2019	Circuit1852	14	15	21	17	1	1	1	1
2019	2019	Circuit1853	4	6	11	7	188	410	49	216
2019	2019	Circuit1854	775	520	96	464	120	216	180	172
2019	2019	Circuit1433	154	1496	784	811	604	570	824	666

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		All Weather CI Control Group								
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit1434	354	1721	630	902	899	1,931	1,424	1418
2019	2019	Circuit2145	35	327	43	135	74	883	4	320
2019	2019	Circuit2146	609	3056	955	1540	989	2,271	122	1127
2019	2019	Circuit2147	41	445	18	168	356	1,739	417	837
2019	2019	Circuit4091				#DIV/0!		0	0	0
2019	2019	Circuit1298	34	42	451	176	330	127	574	344
2019	2019	Circuit3717				#DIV/0!		0	0	0
2019	2019	Circuit3735	16	2		9		0	0	0
2019	2019	Circuit3677	1			1		0	0	0
2019	2019	Circuit1878	131	149	3267	1182	506	160	169	278
2019	2019	Circuit1879			2	2	11	8	13	11
2019	2019	Circuit1880	59	819	111	330	974	6,735	3,033	3581
2019	2019	Circuit2150	1541	2764	2824	2376	3408	2,689	2,826	2974
2019	2019	Circuit3721				#DIV/0!		0	0	0
2019	2019	Circuit3314	30	23	32	28	2	0	0	1
2019	2019	Circuit3316	9	33	24	22	106	56	12	58
2019	2019	Circuit3317	564	41	57	221	415	509	770	565
2019	2019	Circuit3318	79	402	15	165	34	11	31	25
2019	2019	Circuit3319	606	16	34	219	101	202	47	117
2019	2019	Circuit3320	32	62	84	59	97	176	1,054	442
2019	2019	Circuit3321	60	986	854	633	132	408	206	249
2019	2019	Circuit3322	17	7	28	17	13	65	418	165
2019	2019	Circuit3323	8	343	8	120	635	113	45	264
2019	2019	Circuit3324	58	5	26	30	857	36	119	337
2019	2019	Circuit2167	90	1830	119	680	79	200	949	409
2019	2019	Circuit2165	550	647	1687	961	502	616	27	382
2019	2019	Circuit2166	150	1295	664	703	238	1,240	42	507
2019	2019	Circuit3395	880	866	794	847	974	3,077	625	1559
2019	2019	Circuit3397	3	111	108	74	626	89	109	275
2019	2019	Circuit3398	55	226	31	104	615	133	716	488
2019	2019	Circuit3399		72		72	3	4	4	4
2019	2019	Circuit3400	1070	832	945	949	3166	1,188	534	1629
2019	2019	Circuit3724				#DIV/0!		0	0	0
2019	2019	Circuit1907	1			1	1	1	22	8
2019	2019	Circuit1908	1		6	4	141	0	636	259
2019	2019	Circuit1910	52	1618	25	565	728	45	2,449	1074
2019	2019	Circuit1912	1597	176	2807	1527	1362	3,222	7,328	3971
2019	2019	Circuit1926	796	501	26	441	19	6	4	10
2019	2019	Circuit1009	1	8	30	13	869	887	124	627
2019	2019	Circuit1010	51	824	489	455	547	1,340	199	695
2019	2019	Circuit1011	8	9	778	265	348	508	36	297
2019	2019	Circuit1012	3	701	25	243	316	955	72	448
2019	2019	Circuit1013	6	1146	273	475	670	271	591	511
2019	2019	Circuit1014	8	694	1385	696	659	1,355	711	908

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit1016	1189	747	230	722	1424	1,691	1,492	1536
2019	2019	Circuit1017	17	582	599	399	1183	1,830	1,162	1392
2019	2019	Circuit1018	4	26	44	25	444	200	5	216
2019	2019	Circuit1019	43	2535	994	1191	1099	75	963	712
2019	2019	Circuit1022	51	1632	1172	952	2022	989	70	1027
2019	2019	Circuit1023	4	764	334	367	336	331	342	336
2019	2019	Circuit3732	145			145		0	0	0
2019	2019	Circuit1936	3	1	5	3		4	1	3
2019	2019	Circuit1938	3			3		4	6	5
2019	2019	Circuit1939	65	816	2396	1092	191	511	298	333
2019	2019	Circuit1940	228	3858	2104	2063	531	815	472	606
2019	2019	Circuit1941	143	208	4022	1458	1954	1,421	348	1241
2019	2019	Circuit1024	31	163	88	94	11	38	56	35
2019	2019	Circuit1026	1	3	590	198	5	258	1	88
2019	2019	Circuit1028	74	2	554	210	1	176	0	59
2019	2019	Circuit1029	4	16	40	20	11	39	2	17
2019	2019	Circuit1030	1		181	91	1	264	1	89
2019	2019	Circuit1031			2	2		1	0	1
2019	2019	Circuit1032	3	1	84	29	105	1	10	39
2019	2019	Circuit1033	2	1	115	39		3	0	2
2019	2019	Circuit1034		1	21	11		6	3	5
2019	2019	Circuit3725				#DIV/0!		0	0	0
2019	2019	Circuit3726				#DIV/0!		0	0	0
2019	2019	Circuit1037	7	16		12		0	0	0
2019	2019	Circuit3729	982	20		501		0	0	0
2019	2019	Circuit3484	81	90	13	61	65	41	228	111
2019	2019	Circuit3722	1			1		0	0	0
2019	2019	Circuit3486	53	84	40	59		20	4	12
2019	2019	Circuit3487	84	6	9	33	4	70	3	26
2019	2019	Circuit3488	44	1	37	27	11	8	40	20
2019	2019	Circuit3489			324	324	1285	2,303	142	1243
2019	2019	Circuit3490	802	59	286	382	628	2,184	167	993
2019	2019	Circuit3690	7	2		5		0	0	0
2019	2019	Circuit3491	1085	219	1366	890	421	759	1,119	766
2019	2019	Circuit3492	854	972	42	623	40	275	459	258
2019	2019	Circuit3493	2040	932	660	1211	1173	597	337	702
2019	2019	Circuit3495	24	219	43	95	763	1,061	1,319	1048
2019	2019	Circuit3496	639	69	665	458	30	897	1,918	948
2019	2019	Circuit3497	76	139	184	133	276	1,589	954	940
2019	2019	Circuit3498	95	1011	674	593	1457	534	1,244	1078
2019	2019	Circuit3499	1215	2041	1187	1481	167	255	1,006	476
2019	2019	Circuit3501	124	2206	3014	1781	498	2,858	1,914	1757
2019	2019	Circuit3502	1647	4974	3245	3289	2093	2,116	2,307	2172
2019	2019	Circuit3503	33	53	931	339	418	472	1,796	895

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2019	2019	Circuit3509	11	738	92	280	81	663	47	264
2019	2019	Circuit3510	1127	67	1600	931	280	1,700	1,142	1041
2019	2019	Circuit3511	64	9	108	60	761	1,624	90	825
2019	2019	Circuit3513	2		222	112	8	155	79	81
2019	2019	Circuit3723				#DIV/0!		0	0	0
2019	2019	Circuit3535	6			6		0	0	0
2019	2019	Circuit3686	14	1		8		0	0	0
2019	2019	Circuit3536				#DIV/0!		1	1	1
2019	2019	Circuit3537		7	65	36	11	8	17	12
2019	2019	Circuit3688			18	18		0	0	0
2019	2019	Circuit3619	71	257	1589	639		0	0	0
2019	2019	Circuit3621	1270	1611	25	969		0	0	0
2019	2019	Circuit1047	63	53	2251	789	128	74	131	111
2019	2019	Circuit1048	97	984	323	468	281	355	1,009	548
2019	2019	Circuit2376				#DIV/0!	1452	320	138	637
2019	2019	Circuit1049	70	305	221	199	1319	151	1,068	846
2019	2019	Circuit2377			4	4	2500	441	2,018	1653
2019	2019	Circuit2378				#DIV/0!	1001	438	1,704	1048
2020	2020	Circuit3715	1		0	1		0	0	0
2020	2020	Circuit3720	1		0	1		0	0	0
2020	2020	Circuit206	832	96	218	382	19	564	558	380
2020	2020	Circuit208	259	15	35	103	51	19	910	327
2020	2020	Circuit211	246	210	1587	681	122	1,484	106	571
2020	2020	Circuit2434	13	38	37	29	28	356	30	138
2020	2020	Circuit2438	131	2	189	107	7	23	54	28
2020	2020	Circuit2439	1987	719	39	915	901	77	850	609
2020	2020	Circuit3624	1		0	1		0	-	0
2020	2020	Circuit2441			7	7	1	9	5	5
2020	2020	Circuit2442	294	1230	1108	877	1503	1,214	4,105	2274
2020	2020	Circuit2443	672	108	163	314	111	789	1,646	849
2020	2020	Circuit2444	723	322	57	367	1494	830	214	846
2020	2020	Circuit2445	628	15	806	483	566	715	737	673
2020	2020	Circuit2446	46	654	273	324	878	147	81	369
2020	2020	Circuit2447	14	76	485	192	423	2,320	1,382	1375
2020	2020	Circuit2455	2	5	0	2	2	3	3	3
2020	2020	Circuit2460	1	3	73	26	297	870	196	454
2020	2020	Circuit2466	3		0	2		3	0	2
2020	2020	Circuit2472	37	35	8	27	133	345	62	180
2020	2020	Circuit2473	570	13	774	452	864	621	111	532
2020	2020	Circuit2474	22	236	168	142	8	28	197	78
2020	2020	Circuit1595	1		0	1		0	0	0
2020	2020	Circuit3741	11		0	6		0	0	0
2020	2020	Circuit2019	23	8	13	15	43	4	103	50
2020	2020	Circuit2020	186	8	42	79	354	121	403	293

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit2023	1128	88	439	552	1508	597	3,711	1939
2020	2020	Circuit2025	1318	894	214	809	1019	449	2,716	1395
2020	2020	Circuit3728			0	0		0	0	0
2020	2020	Circuit1629	28	106	13	49	458	1,837	1,140	1145
2020	2020	Circuit1630	1840	1023	1000	1288	887	54	1,813	918
2020	2020	Circuit1631	108	675	117	300	1312	621	511	815
2020	2020	Circuit1632	92	645	100	279	1173	230	331	578
2020	2020	Circuit1633	2019	1470	45	1178	2252	912	1,446	1537
2020	2020	Circuit2559	251	1331	162	581	671	234	1,291	732
2020	2020	Circuit1634	193	297	208	233	603	242	55	300
2020	2020	Circuit2566	174	690	185	350	283	318	881	494
2020	2020	Circuit2578	1531	1300	1668	1500	2166	279	4,000	2148
2020	2020	Circuit2579	82	172	1799	684	2051	189	41	760
2020	2020	Circuit3730			0	0		0	0	0
2020	2020	Circuit1238			0	0		0	0	0
2020	2020	Circuit1244	5	109	640	251	116	1,566	28	570
2020	2020	Circuit1245	180	39	580	266	199	26	1,095	440
2020	2020	Circuit1246	625	400	303	443	39	282	134	152
2020	2020	Circuit3710			0	0		0	0	0
2020	2020	Circuit828	2352	1796	2341	2163	541	516	1,990	1016
2020	2020	Circuit829	3840	3219	3628	3562	309	485	812	535
2020	2020	Circuit830	969	628	1974	1190	347	1,030	284	554
2020	2020	Circuit832	1843	499	423	922	908	1,156	2,255	1440
2020	2020	Circuit835	2443	2031	713	1729	1095	2,491	1,264	1617
2020	2020	Circuit3578	624		0	312		0	-	0
2020	2020	Circuit2679			0	0	14	26	41	27
2020	2020	Circuit2681			6	6	217	739	547	501
2020	2020	Circuit3736	2342		0	1171		0	0	0
2020	2020	Circuit3733			0	0		0	0	0
2020	2020	Circuit1663	312	896	98	435	911	328	109	449
2020	2020	Circuit1664	842	1946	67	952	885	201	791	626
2020	2020	Circuit1665	585	1063	33	560	703	131	927	587
2020	2020	Circuit1666	6334	198	132	2221	1339	465	3,338	1714
2020	2020	Circuit1668	329	855	36	407	1614	1,575	868	1352
2020	2020	Circuit1669	269	859	81	403	1132	227	2,174	1178
2020	2020	Circuit3743	1		0	1		0	0	0
2020	2020	Circuit3742	1		0	1		0	0	0
2020	2020	Circuit3739	1		0	1		0	0	0
2020	2020	Circuit3711			0	0		0	0	0
2020	2020	Circuit1684	524	573	21	373	599	24	563	395
2020	2020	Circuit1685	2198	128	1043	1123	1186	14	1,208	803
2020	2020	Circuit1686	1307	26	22	452	1512	132	654	766
2020	2020	Circuit1687	794	78	60	311	957	104	226	429
2020	2020	Circuit1688	1457	1434	2383	1758	111	62	2,851	1008

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All Weather CI Control Group									
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after
2020	2020	Circuit2729	1		1	1		2	0
2020	2020	Circuit2730		5	0	3		0	0
2020	2020	Circuit2732		3	0	2		1	0
2020	2020	Circuit2733		52	3	28	57	5	106
2020	2020	Circuit2734	413	695	52	387	750	563	1,311
2020	2020	Circuit2737	1302	2210	124	1212	97	2,542	3,759
2020	2020	Circuit2738	364	377	59	267	275	49	923
2020	2020	Circuit2739	1070	1048	142	753	477	984	3,665
2020	2020	Circuit2740	1838	2495	130	1488	1326	60	1,689
2020	2020	Circuit2741	819	201	163	394	1351	1,279	1,976
2020	2020	Circuit2742	1585	2306	123	1338	353	1,492	6,167
2020	2020	Circuit2744	943	928	1727	1199	1001	406	1,554
2020	2020	Circuit2745	36	829	133	333	81	405	3,301
2020	2020	Circuit2746	71	2935	118	1041	328	1,239	2,169
2020	2020	Circuit2752	101	1230	103	478	120	1,233	1,774
2020	2020	Circuit2753	11	83	227	107	245	56	137
2020	2020	Circuit2754	499	188	1170	619	113	93	223
2020	2020	Circuit2755	115	91	457	221	143	20	674
2020	2020	Circuit2756	53	342	30	142	27	42	58
2020	2020	Circuit4087			0	0		0	0
2020	2020	Circuit875	886	1520	1505	1304	2581	727	138
2020	2020	Circuit876	1278	63	568	636	1332	1,393	371
2020	2020	Circuit3712			0	0		0	0
2020	2020	Circuit3716	1		0	1		0	0
2020	2020	Circuit3587	1014	1478	345	946		0	-
2020	2020	Circuit1701	2611	2982	1684	2426		0	-
2020	2020	Circuit3588	743	233	1141	706		0	-
2020	2020	Circuit2060	263	1700	1320	1094	22	68	1,007
2020	2020	Circuit4088	1		0	1		0	0
2020	2020	Circuit2790	1281	426	140	616	1075	988	337
2020	2020	Circuit2791	263	211	446	307	613	243	1,072
2020	2020	Circuit2792	2264	900	1595	1586	2728	795	2,123
2020	2020	Circuit2794	856	993	217	689	893	1,101	1,202
2020	2020	Circuit2807	8	752	819	526	20	31	770
2020	2020	Circuit2808	696	59	825	527	1199	282	114
2020	2020	Circuit887	66	542	311	306	841	767	105
2020	2020	Circuit888	1159	10	199	456	610	177	43
2020	2020	Circuit2063	1275	90	388	584	218	228	1,079
2020	2020	Circuit3718			0	0		0	0
2020	2020	Circuit2067	53	216	33	101	435	19	89
2020	2020	Circuit2068	693	1234	917	948	2783	202	481
2020	2020	Circuit2070	270	776	509	518	2218	2,225	784
2020	2020	Circuit2071	190	998	235	474	1260	93	676
2020	2020	Circuit2072	481	989	82	517	920	80	97

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit3740	1		0	1		0	0	0
2020	2020	Circuit3622			0	0	3	0	0	1
2020	2020	Circuit3643			0	0	1	0	-	1
2020	2020	Circuit3623	207		195	201	140	0	0	47
2020	2020	Circuit897	153	163	9	108	1	1	2	1
2020	2020	Circuit901	136	41	31	69	88	7	183	93
2020	2020	Circuit903	66	49	19	45	132	21	42	65
2020	2020	Circuit3734	4		0	2		0	0	0
2020	2020	Circuit1708	1169	224	1213	869	155	2,137	223	838
2020	2020	Circuit1709	865	49	85	333	151	1,783	700	878
2020	2020	Circuit2083	934	122	2551	1202	55	133	1,101	430
2020	2020	Circuit2084	604	31	1066	567	1716	26	1,208	983
2020	2020	Circuit2085	99	1740	880	906	96	41	2,501	879
2020	2020	Circuit2086	2069		0	1035		0	0	0
2020	2020	Circuit3731			0	0		0	0	0
2020	2020	Circuit2087	31	58	518	202	3006	720	920	1549
2020	2020	Circuit2088	1149	4061	3844	3018	5074	137	3,404	2872
2020	2020	Circuit1719			3	3	1	1	0	1
2020	2020	Circuit1727	5	20	1	9	1	0	12	4
2020	2020	Circuit1728	6	17	53	25	209	27	149	128
2020	2020	Circuit1729		4	2	3	5	1	94	33
2020	2020	Circuit1730	19	2	12	11	11	5	1	6
2020	2020	Circuit1732	1131	71	202	468	281	380	3,309	1323
2020	2020	Circuit1733	1811	1130	324	1088	1107	825	206	713
2020	2020	Circuit1734	1773	3074	155	1667	1104	224	702	677
2020	2020	Circuit1735	1342	5416	1739	2832	1845	598	2,270	1571
2020	2020	Circuit1736	1019	1576	1690	1428	1267	523	2,088	1293
2020	2020	Circuit1737	175	581	1414	723	1044	133	2,132	1103
2020	2020	Circuit1738	1159	4546	1208	2304	3202	372	7,585	3720
2020	2020	Circuit1739	258	1661	449	789	1341	645	2,748	1578
2020	2020	Circuit2859	406	801	330	512	61	687	2,134	961
2020	2020	Circuit1401	394	386	11	264	892	16	1,143	684
2020	2020	Circuit1402	171	1429	695	765	1448	107	2,734	1430
2020	2020	Circuit3738	1		0	1		0	0	0
2020	2020	Circuit2862	3		2	3	21	1	29	17
2020	2020	Circuit2863	33	2	1	12	31	25	201	86
2020	2020	Circuit2864	42	370	388	267	270	43	283	199
2020	2020	Circuit2865	772	1731	333	945	180	799	731	570
2020	2020	Circuit2866	123	985	865	658	439	303	2,003	915
2020	2020	Circuit2869	652	646	892	730	684	595	1,637	972
2020	2020	Circuit2870	1419	1463	1416	1433	1512	1,524	1,684	1573
2020	2020	Circuit2877	857	932	1104	964	2167	287	724	1059
2020	2020	Circuit2878	2863		0	1432		0	0	0
2020	2020	Circuit2879	740	19	592	450	581	255	557	464

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit2881	332	340	1521	731	1415	1,309	234	986
2020	2020	Circuit2882	57	326	324	236	317	101	11	143
2020	2020	Circuit2884	2	987	477	489	110	1,428	1,149	896
2020	2020	Circuit2885	202	496	2286	995	3826	1,413	2,446	2562
2020	2020	Circuit2886	820	901	804	842	742	58	134	311
2020	2020	Circuit2887	570	419	1481	823	1136	1,037	802	992
2020	2020	Circuit2888	17	29	1297	448	1648	44	112	601
2020	2020	Circuit2889	10	30	2446	829	1634	1,315	377	1109
2020	2020	Circuit2890	136	210	730	359	772	532	281	528
2020	2020	Circuit2895	66	1505	37	536	1084	643	1,094	940
2020	2020	Circuit3727			0	0		0	0	0
2020	2020	Circuit3719			0	0		0	0	0
2020	2020	Circuit3590	5	30	20	18		0	-	0
2020	2020	Circuit3591	16	47	46	36		0	-	0
2020	2020	Circuit3592	60	1620	492	724		0	-	0
2020	2020	Circuit3594	7		40	24		0	-	0
2020	2020	Circuit3595	1091	1020	1397	1169		0	-	0
2020	2020	Circuit1752	637	176	63	292	466	361	579	469
2020	2020	Circuit1753	98	72	28	66	179	570	526	425
2020	2020	Circuit1759	1147	710	196	684	762	835	1,263	953
2020	2020	Circuit1754	184	106	24	105	1456	596	1,172	1075
2020	2020	Circuit1755	431	444	68	314	760	829	352	647
2020	2020	Circuit1756	570	1147	685	801	865	1,638	641	1048
2020	2020	Circuit2932	157	850	573	527	1212	335	2,008	1185
2020	2020	Circuit2933	1467	578	259	768	418	276	4,204	1633
2020	2020	Circuit2934	2178	1153	794	1375	813	509	3,959	1760
2020	2020	Circuit2935	128	1252	1418	933	568	1,354	3,405	1776
2020	2020	Circuit2936	50	310	74	145	92	130	192	138
2020	2020	Circuit2937	9	729	141	293	821	58	52	310
2020	2020	Circuit1250	14	9	4	9	10	10	4	8
2020	2020	Circuit1252	242	151	234	209	480	434	101	338
2020	2020	Circuit1253	944	654	1094	897	1574	936	1,779	1430
2020	2020	Circuit1255	118	100	203	140	1902	2,257	529	1563
2020	2020	Circuit1256	3033	1751	122	1635	2508	1,343	1,102	1651
2020	2020	Circuit1257		37	143	90	19	18	15	17
2020	2020	Circuit944	17	37	103	52	1539	371	641	850
2020	2020	Circuit945		2	3	3	40	1	0	14
2020	2020	Circuit946	215	23	705	314	1587	1,169	646	1134
2020	2020	Circuit947	1	9	159	56	505	210	1	239
2020	2020	Circuit3649		1	0	1		0	-	0
2020	2020	Circuit1766	485	215	26	242	520	858	1,073	817
2020	2020	Circuit1768	2	27	73	34	707	229	2,996	1311
2020	2020	Circuit1769	654	18	44	239	2554	1,189	1,538	1760
2020	2020	Circuit1771			2	2		0	10	5

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All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit1772	606	493	492	530	391	409	17	272
2020	2020	Circuit1773	5609	1176	856	2547	1909	576	753	1079
2020	2020	Circuit1774	8017	652	731	3133	687	57	1,138	627
2020	2020	Circuit948	13		0	7		0	0	0
2020	2020	Circuit951	192	838	833	621	500	132	1,072	568
2020	2020	Circuit952	1417	1934	157	1169	171	593	1,040	601
2020	2020	Circuit953	1073	1048	845	989	299	213	705	406
2020	2020	Circuit954	2484	1408	1804	1899	1438	83	2,513	1345
2020	2020	Circuit955	1279	1256	803	1113	1440	1,021	1,036	1166
2020	2020	Circuit4089			0	0		0	0	0
2020	2020	Circuit2993	13	2	2	6		3	14	9
2020	2020	Circuit2994	65	1	4	23	51	19	53	41
2020	2020	Circuit2995	1519	189	242	650	602	1,151	1,912	1222
2020	2020	Circuit2996	738	188	1417	781	289	96	969	451
2020	2020	Circuit2997	714	46	32	264	492	80	690	421
2020	2020	Circuit2998	1004	2072	1413	1496	475	846	2,429	1250
2020	2020	Circuit2999	895	1780	2856	1844	422	179	1,596	732
2020	2020	Circuit3737	1		0	1		0	0	0
2020	2020	Circuit3598			329	329		0	-	0
2020	2020	Circuit3041	3	666	129	266	1450	237	2,292	1326
2020	2020	Circuit3056	6	160	98	88	3	122	85	70
2020	2020	Circuit3064	523	459	31	338	918	423	45	462
2020	2020	Circuit3065	2374	1489	78	1314	2986	1,618	547	1717
2020	2020	Circuit3066	1637	3319	335	1764	1624	1,432	1,031	1362
2020	2020	Circuit3069		6	0	3	1	0	0	0
2020	2020	Circuit1779	1487	1559	42	1029	1523	36	179	579
2020	2020	Circuit3070	1070	1361	61	831	673	87	74	278
2020	2020	Circuit3071	647	87	2001	912	136	24	1,638	599
2020	2020	Circuit3072	654	755	27	479	1452	471	2,231	1385
2020	2020	Circuit3073	323	814	437	525	902	1,102	723	909
2020	2020	Circuit3074	181	1720	1363	1088	136	944	1,115	732
2020	2020	Circuit1780	22	2	37	20	2102	172	1,063	1112
2020	2020	Circuit1782		4	13	9	69	11	41	40
2020	2020	Circuit1783		16	14	15	72	14	0	29
2020	2020	Circuit1785	36	2	7	15	172	16	53	80
2020	2020	Circuit1788			2	2	23	13	15	17
2020	2020	Circuit1789	194	744	1314	751	5867	1,007	417	2430
2020	2020	Circuit1790	1469	1803	801	1358	4008	212	111	1444
2020	2020	Circuit1791	19	948	78	348	1716	4,084	1,650	2483
2020	2020	Circuit1792	1507	291	392	730	7538	486	1,731	3252
2020	2020	Circuit1793	59	30	12	34	1478	2,725	1,459	1887
2020	2020	Circuit1794	1083	932	1093	1036	2268	1,581	-	1925
2020	2020	Circuit1795		77	0	39	789	1,825	685	1100
2020	2020	Circuit3657	56		0	28		0	-	0

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4.8kV Hardening Data

			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit3606	1	3	7	4		0	-	0
2020	2020	Circuit3607			0	0		0	-	0
2020	2020	Circuit3608		2	2	2		0	0	0
2020	2020	Circuit3609		1	9	5		10	-	10
2020	2020	Circuit3660			3	3		0	-	0
2020	2020	Circuit3713			0	0		0	0	0
2020	2020	Circuit3662			0	0		0	-	0
2020	2020	Circuit3663	2		0	1		0	-	0
2020	2020	Circuit3611	32	81	60	58	3	2	-	3
2020	2020	Circuit3714	1		0	1		0	0	0
2020	2020	Circuit3096	1		16	9	81	6	41	43
2020	2020	Circuit3097	418	241	490	383	3211	1,686	2,675	2524
2020	2020	Circuit3099	273	79	1229	527	801	1,814	1,047	1221
2020	2020	Circuit3100	843	799	327	656	863	1,235	1,072	1057
2020	2020	Circuit3101	3700	1353	1385	2146	2227	1,800	4,187	2738
2020	2020	Circuit3102	91	142	823	352	103	1,115	979	732
2020	2020	Circuit1798	1687	1215	2689	1864	1907	1,343	1,141	1464
2020	2020	Circuit1799	860	2710	829	1466	3256	656	397	1436
2020	2020	Circuit1800	258	424	651	444	1912	1,401	983	1432
2020	2020	Circuit1801	944	1340	694	993	773	1,084	943	933
2020	2020	Circuit1802	824	2132	1484	1480	893	241	218	451
2020	2020	Circuit1803	8	1	23	11	29	28	4	20
2020	2020	Circuit1804	399	521	1624	848	1947	609	306	954
2020	2020	Circuit1805			8	8	31	0	38	23
2020	2020	Circuit3124		4	11	8	7	27	12	15
2020	2020	Circuit3126	10	26	7	14	2	5	7	5
2020	2020	Circuit3131	152	230	161	181	1163	1,085	2,723	1657
2020	2020	Circuit4090	1		0	1		0	0	0
2020	2020	Circuit1812	4	5	49	19	59	133	152	115
2020	2020	Circuit1815	2	22	19	14	3	2	8	4
2020	2020	Circuit1816			1	1		2	5	4
2020	2020	Circuit1817			0	0	1	2	3	2
2020	2020	Circuit1818	16	6	4	9		2	6	4
2020	2020	Circuit1819	5	52	46	34	40	5	28	24
2020	2020	Circuit1820	547	79	223	283	852	323	399	525
2020	2020	Circuit1821	1624	2312	2880	2272	22	933	399	451
2020	2020	Circuit1822	92	24	162	93	39	12	71	41
2020	2020	Circuit1823	11	1331	1386	909	209	52	486	249
2020	2020	Circuit1824	82	271	1104	486	1913	2,944	7,173	4010
2020	2020	Circuit1825	3373	1470	1270	2038	710	2,357	3,854	2307
2020	2020	Circuit1826	4	827	1316	716	81	897	1,855	944
2020	2020	Circuit3156			0	0		0		1
2020	2020	Circuit1827	3	32	33	23	1254	78	25	452
2020	2020	Circuit1828	643	396	448	496	247	11	988	415

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4.8kV Hardening Data

All Weather CI Control Group										
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit1829	238	162	313	238	417	557	474	483
2020	2020	Circuit1830	395	65	509	323	1234	204	615	684
2020	2020	Circuit3184	19	3	16	13	12	7	10	10
2020	2020	Circuit3185	39	1850	1425	1105	5019	3,618	196	2944
2020	2020	Circuit3186	1403	742	492	879	46	838	1,441	775
2020	2020	Circuit3187	853	71	44	323	1021	129	1,434	861
2020	2020	Circuit3188	33	802	882	572	1832	632	385	950
2020	2020	Circuit3189	133		0	67		0	0	0
2020	2020	Circuit3190	16	20	20	19	154	115	853	374
2020	2020	Circuit3192	241	1189	306	579	2669	995	1,148	1604
2020	2020	Circuit3193	166	338	842	449	380	87	561	343
2020	2020	Circuit3194	77	1066	2132	1092	1137	1,210	1,598	1315
2020	2020	Circuit3195	1680	1331	716	1242	3080	3,142	3,814	3345
2020	2020	Circuit1839	29	124	92	82	971	94	167	411
2020	2020	Circuit1845	434	846	802	694	625	59	749	478
2020	2020	Circuit1846	421	456	104	327	273	47	169	163
2020	2020	Circuit1847	53		0	27	13	584	0	199
2020	2020	Circuit1848	637	769	373	593	1167	60	304	510
2020	2020	Circuit1849	337	75	835	416	29	273	207	170
2020	2020	Circuit1850	2	5	1	3	3	0	4	2
2020	2020	Circuit1851	514	195	246	318	187	259	848	431
2020	2020	Circuit1852	15	21	5	14	1	1	0	1
2020	2020	Circuit1853	6	11	311	109	410	49	565	341
2020	2020	Circuit1854	520	96	437	351	216	180	84	160
2020	2020	Circuit1434	1721	630	1910	1420	1931	1,424	3,090	2148
2020	2020	Circuit4091			0	0		0	0	0
2020	2020	Circuit3717			0	0		0	0	0
2020	2020	Circuit3735	2		0	1		0	0	0
2020	2020	Circuit3677			0	0		0	-	0
2020	2020	Circuit2150	2764	2824	2162	2583	2689	2,826	3,038	2851
2020	2020	Circuit3721			0	0		0	0	0
2020	2020	Circuit3314	23	32	0	18		0	4	2
2020	2020	Circuit3316	33	24	18	25	56	12	43	37
2020	2020	Circuit3317	41	57	501	200	509	770	1,521	933
2020	2020	Circuit3318	402	15	23	147	11	31	78	40
2020	2020	Circuit3319	16	34	699	250	202	47	633	294
2020	2020	Circuit3320	62	84	123	90	176	1,054	205	478
2020	2020	Circuit3321	986	854	95	645	408	206	770	461
2020	2020	Circuit3322	7	28	10	15	65	418	51	178
2020	2020	Circuit3323	343	8	13	121	113	45	137	98
2020	2020	Circuit3324	5	26	750	260	36	119	217	124
2020	2020	Circuit3395	866	794	2466	1375	3077	625	1,776	1826
2020	2020	Circuit3397	111	108	582	267	89	109	12	70
2020	2020	Circuit3398	226	31	97	118	133	716	697	515

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			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit3399	72		3	38	4	4	1	3
2020	2020	Circuit3400	832	945	860	879	1188	534	2,602	1441
2020	2020	Circuit3724			0	0		0	0	0
2020	2020	Circuit1461			2	2		0	0	0
2020	2020	Circuit1926	501	26	22	183	6	4	27	12
2020	2020	Circuit1009	8	30	117	52	887	124	720	577
2020	2020	Circuit1010	824	489	2361	1225	1340	199	258	599
2020	2020	Circuit1012	701	25	853	526	955	72	1,364	797
2020	2020	Circuit1013	1146	273	526	648	271	591	31	298
2020	2020	Circuit1014	694	1385	1417	1165	1355	711	83	716
2020	2020	Circuit1016	747	230	684	554	1691	1,492	347	1177
2020	2020	Circuit1017	582	599	41	407	1830	1,162	606	1199
2020	2020	Circuit1018	26	44	560	210	200	5	122	109
2020	2020	Circuit1019	2535	994	607	1379	75	963	25	354
2020	2020	Circuit1022	1632	1172	149	984	989	70	125	395
2020	2020	Circuit1023	764	334	495	531	331	342	121	265
2020	2020	Circuit3732			0	0		0	0	0
2020	2020	Circuit1030		181	2	92	264	1	30	98
2020	2020	Circuit3725			0	0		0	0	0
2020	2020	Circuit3726			0	0		0	0	0
2020	2020	Circuit1037	16		0	8		0	0	0
2020	2020	Circuit3729	20		0	10		0	0	0
2020	2020	Circuit3484	90	13	1	35	41	228	9	93
2020	2020	Circuit3722			0	0		0	0	0
2020	2020	Circuit3486	84	40	3	42	20	4	88	37
2020	2020	Circuit3487	6	9	44	20	70	3	73	49
2020	2020	Circuit3488	1	37	8	15	8	40	64	37
2020	2020	Circuit3489		324	238	281	2303	142	513	986
2020	2020	Circuit3490	59	286	178	174	2184	167	1,038	1130
2020	2020	Circuit3690	2		0	1		0	0	0
2020	2020	Circuit3491	219	1366	1526	1037	759	1,119	393	757
2020	2020	Circuit3492	972	42	545	520	275	459	222	319
2020	2020	Circuit3493	932	660	785	792	597	337	1,119	684
2020	2020	Circuit3495	219	43	107	123	1061	1,319	76	819
2020	2020	Circuit3496	69	665	671	468	897	1,918	28	948
2020	2020	Circuit3497	139	184	565	296	1589	954	3,606	2050
2020	2020	Circuit3498	1011	674	119	601	534	1,244	288	689
2020	2020	Circuit3499	2041	1187	86	1105	255	1,006	332	531
2020	2020	Circuit3501	2206	3014	120	1780	2858	1,914	3,148	2640
2020	2020	Circuit3502	4974	3245	2412	3544	2116	2,307	1,511	1978
2020	2020	Circuit3503	53	931	79	354	472	1,796	1,559	1276
2020	2020	Circuit3509	738	92	1399	743	663	47	646	452
2020	2020	Circuit3510	67	1600	189	619	1700	1,142	1,198	1347
2020	2020	Circuit3511	9	108	35	51	1624	90	1,116	943

			All Weather CI Control Group							
Year	Year	Circuit	3 yrs. before	2 yrs. before	1 yr. before	3 Year Avg	1 yr. after	2 yrs. after	3 yrs. after	3 Year Avg
2020	2020	Circuit3513		222	31	127	155	79	220	151
2020	2020	Circuit3723			0	0		0	0	0
2020	2020	Circuit3535			0	0		0	0	0
2020	2020	Circuit3686	1		0	1		0	-	0
2020	2020	Circuit3536			0	0	1	1	0	1
2020	2020	Circuit3537	7	65	43	38	8	17	17	14
2020	2020	Circuit3688		18	0	9		0	-	0
2020	2020	Circuit3619	257	1589	2140	1329		0	-	0
2020	2020	Circuit3621	1611	25	2885	1507		0	-	0
2020	2020	Circuit2376				#DIV/0!	320	138	1,872	777
2020	2020	Circuit2377		4	9	7	441	2,018	2,937	1799
2020	2020	Circuit2378			17	17	438	1,704	2,590	1577

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Sum 2018-2020	67,043	67,789	68,356	67,729	71,866	73,282	71,698	72,282

Year	Circuit	Customer Count							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2018	Circuit2509	511	511	499	507	516	565	612	564
2018	Circuit814	1,090	1,090	1,104	1,095	1,131	1,234	1,257	1,207
2018	Circuit816	743	743	754	747	788	858	882	843
2018	Circuit1860	214	214	217	215	220	229	231	227
2018	Circuit1861	932	932	927	930	965	1,050	1,054	1,023
2018	Circuit3249	667	667	662	665	677	726	747	717
2018	Circuit1863	739	739	728	735	738	812	828	793
2018	Circuit1865	1,176	1,176	1,206	1,186	1,243	1,312	1,315	1,290
2018	Circuit1867	675	675	646	665	685	727	741	718
2018	Circuit1869	1,028	1,028	1,027	1,028	1,076	1,122	1,142	1,113
2019	Circuit1608	635	639	654	643	675	677	677	676
2019	Circuit1610	1,464	1,465	1,491	1,473	1,552	1,541	1,541	1,545
2019	Circuit1612	1,039	1,046	1,067	1,051	1,114	1,118	1,118	1,117
2019	Circuit1613	-	-	-	-	-	-	-	-
2019	Circuit1614	975	998	1,024	999	1,054	1,053	1,053	1,053
2019	Circuit1615	927	923	936	929	953	953	953	953
2019	Circuit1616	613	624	630	622	603	635	635	624
2019	Circuit1617	812	811	819	814	831	844	844	840
2019	Circuit1618	696	725	728	716	734	742	742	739
2019	Circuit813	456	447	466	456	509	537	537	528
2019	Circuit815	620	641	652	638	577	687	687	650
2019	Circuit817	814	745	763	774	898	927	927	917
2019	Circuit818	944	966	981	964	1,033	1,067	1,067	1,056
2019	Circuit2510	881	879	924	895	813	1,025	1,025	954
2019	Circuit819	631	629	636	632	673	726	726	708
2019	Circuit2511	837	826	852	838	828	990	990	936
2019	Circuit2512	590	585	615	597	675	741	741	719
2019	Circuit374	1,321	1,336	1,360	1,339	1,401	1,410	1,410	1,407
2019	Circuit1864	911	927	954	931	1,023	1,006	1,006	1,012
2019	Circuit1866	607	610	619	612	628	629	629	629
2019	Circuit1868	944	939	954	946	1,019	1,040	1,040	1,033
2019	Circuit1881	-	-	-	-	-	-	-	-
2019	Circuit1882	888	890	898	892	971	976	976	974
2019	Circuit1883	896	902	907	902	918	922	922	921
2019	Circuit3325	843	845	844	844	847	848	848	848
2019	Circuit3326	1,222	1,224	1,227	1,224	1,236	1,235	1,235	1,235
2019	Circuit1884	1,105	1,106	1,111	1,107	1,141	1,138	1,138	1,139
2019	Circuit1885	810	807	808	808	841	838	838	839
2019	Circuit1886	902	907	906	905	908	907	907	907

Year	Circuit	Customer Count							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2019	Circuit3327	1,053	994	1,029	1,025	1,128	1,133	1,133	1,131
2019	Circuit487	905	901	926	911	1,019	1,036	1,036	1,030
2019	Circuit489	889	878	911	893	1,010	1,008	1,008	1,009
2019	Circuit490	1,189	1,237	1,261	1,229	1,322	1,334	1,334	1,330
2019	Circuit492	1,072	1,080	1,114	1,089	1,222	1,240	1,240	1,234
2019	Circuit495	945	956	996	966	1,042	1,055	1,055	1,051
2020	Circuit1609	1,224	1,237	1,239	1,233	1,272	1,272	1,247	1,264
2020	Circuit55	1,001	1,026	1,027	1,018	1,105	1,105	1,077	1,096
2020	Circuit56	589	613	618	607	612	612	383	536
2020	Circuit57	579	591	591	587	612	612	582	602
2020	Circuit58	1,242	1,252	1,252	1,249	1,257	1,257	1,175	1,230
2020	Circuit60	980	997	998	992	1,081	1,081	1,024	1,062
2020	Circuit61	-	-	-	-	-	-	-	-
2020	Circuit62	399	395	395	396	438	438	414	430
2020	Circuit63	947	965	962	958	1,057	1,057	999	1,038
2020	Circuit64	1,047	1,066	1,065	1,059	1,175	1,175	1,102	1,151
2020	Circuit375	497	510	507	505	542	542	528	537
2020	Circuit376	-	-	-	-	-	-	-	-
2020	Circuit377	750	766	766	761	819	819	794	811
2020	Circuit379	1,038	1,056	1,056	1,050	1,100	1,100	1,063	1,088
2020	Circuit381	1,165	1,204	1,204	1,191	1,250	1,250	1,211	1,237
2020	Circuit382	811	829	833	824	907	907	866	893
2020	Circuit1744	-	-	-	-	-	-	-	-
2020	Circuit1748	810	810	809	810	820	820	812	817
2020	Circuit1750	911	910	908	910	950	950	947	949
2020	Circuit1751	978	984	984	982	1,033	1,033	1,012	1,026
2020	Circuit485	1,168	1,201	1,198	1,189	1,360	1,360	1,337	1,352
2020	Circuit486	-	-	-	-	-	-	-	-
2020	Circuit488	857	874	875	869	990	990	916	965
2020	Circuit491	909	946	946	934	1,049	1,049	991	1,030
2020	Circuit493	1,278	1,303	1,307	1,296	1,522	1,522	1,482	1,509
2020	Circuit494	847	883	882	871	958	958	879	932
2020	Circuit496	-	-	-	-	-	-	-	-
2020	Circuit497	722	747	741	737	852	852	776	827
2020	Circuit498	1,168	1,190	1,186	1,181	1,270	1,270	1,081	1,207
2020	Circuit499	784	783	783	783	800	800	780	793
2020	Circuit500	834	848	849	844	900	900	847	882
2020	Circuit501	908	933	934	925	1,035	1,035	1,055	1,042
2020	Circuit502	1,306	1,340	1,346	1,331	1,418	1,418	1,321	1,386
2020	Circuit503	1,290	1,307	1,307	1,301	1,349	1,349	1,319	1,339
2020	Circuit504	930	1,036	1,036	1,001	1,062	1,062	957	1,027
2020	Circuit505	511	529	524	521	576	576	534	562
2020	Circuit506	1,352	1,395	1,395	1,381	1,458	1,458	1,360	1,425

Michigan Public Service Commission

DTE Electric Company

Discovery Response: U-21534 MNSCDE-3.6-01

4.8kV Hardening Data

U-21534 MNSCDE-3.6-01 4.8kV Hard

Sum 2018-2020	95,865	158,340	118,854	124,353	76,028	49,361	84,981	70,123

Year	Circuit	All Weather CI							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2018	Circuit2509	821	840	568	743	55	54	598	236
2018	Circuit814	1,359	2,092	2,347	1,933	129	113	661	301
2018	Circuit816	591	706	744	680	919	122	136	392
2018	Circuit1860	273	203	1,292	589	224	12	69	102
2018	Circuit1861	1,071	787	2,854	1,571	1,380	697	604	894
2018	Circuit3249	1,397	346	1,750	1,164	788	148	272	403
2018	Circuit1863	896	429	1,567	964	813	241	255	436
2018	Circuit1865	1,658	815	2,581	1,685	413	228	335	325
2018	Circuit1867	908	373	1,782	1,021	808	663	696	722
2018	Circuit1869	1,890	2,164	2,802	2,285	336	382	559	426
2019	Circuit1608	1,335	3,497	626	1,819	1,089	516	201	602
2019	Circuit1610	2,652	5,355	1,521	3,176	3,194	277	667	1,379
2019	Circuit1612	2,715	4,455	3,567	3,579	3,784	1,491	1,469	2,248
2019	Circuit1613	16	-	-	5	-	-	-	-
2019	Circuit1614	1,586	9,731	2,774	4,697	1,457	628	444	843
2019	Circuit1615	1,233	4,495	2,331	2,686	1,514	344	339	732
2019	Circuit1616	1,774	3,359	2,067	2,400	2,196	404	334	978
2019	Circuit1617	1,579	4,300	1,719	2,533	968	474	2,363	1,268
2019	Circuit1618	1,730	3,070	653	1,818	1,457	936	1,706	1,366
2019	Circuit813	546	705	392	548	138	114	75	109
2019	Circuit815	811	3,000	660	1,490	1,836	62	1,763	1,220
2019	Circuit817	657	1,694	1,607	1,319	122	653	1,020	598
2019	Circuit818	950	1,209	819	993	137	662	918	572
2019	Circuit2510	742	1,806	2,378	1,642	1,483	333	866	894
2019	Circuit819	51	780	143	325	591	170	115	292
2019	Circuit2511	1,751	2,176	1,883	1,937	134	54	1,791	660
2019	Circuit2512	674	1,325	1,336	1,112	142	38	1,332	504
2019	Circuit374	1,219	3,821	5,377	3,472	1,231	436	423	697
2019	Circuit1864	402	2,578	4,113	2,364	1,488	744	1,055	1,096
2019	Circuit1866	147	1,768	2,510	1,475	413	37	733	394
2019	Circuit1868	1,143	2,203	3,120	2,155	288	1,151	1,300	913
2019	Circuit1881	-	-	-	-	-	-	-	-
2019	Circuit1882	714	2,858	503	1,358	1,634	916	1,504	1,351
2019	Circuit1883	875	2,807	824	1,502	1,950	271	957	1,059
2019	Circuit3325	317	1,837	1,297	1,150	1,744	28	44	605
2019	Circuit3326	2,822	252	1,446	1,507	2,752	322	143	1,072
2019	Circuit1884	90	1,365	207	554	1,376	735	1,156	1,089
2019	Circuit1885	1,190	169	2,609	1,323	1,187	770	101	686
2019	Circuit1886	53	979	884	639	937	80	64	360

Year	Circuit	All Weather CI							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2019	Circuit3327	162	687	1,201	683	1,104	2,857	328	1,430
2019	Circuit487	104	1,244	2,698	1,349	139	204	1,980	774
2019	Circuit489	138	224	3,680	1,347	282	93	1,054	476
2019	Circuit490	299	386	1,633	773	1,452	293	71	605
2019	Circuit492	119	879	2,693	1,230	1,244	764	3,548	1,852
2019	Circuit495	138	108	1,943	730	40	290	1,008	446
2020	Circuit1609	4,353	367	245	1,655	1,142	145	1,367	885
2020	Circuit55	2,239	1,158	264	1,220	560	1,057	2,215	1,277
2020	Circuit56	707	507	861	692	732	465	1,379	859
2020	Circuit57	2,001	694	1,600	1,432	767	15	1,635	806
2020	Circuit58	132	5,539	798	2,156	204	52	190	149
2020	Circuit60	1,527	2,293	1,152	1,657	750	660	3,499	1,636
2020	Circuit61	-	-	-	-	-	-	-	-
2020	Circuit62	563	479	525	522	56	481	157	231
2020	Circuit63	3,463	3,735	2,942	3,380	562	2,087	2,199	1,616
2020	Circuit64	3,045	2,591	646	2,094	628	1,145	3,403	1,725
2020	Circuit375	2,167	2,449	560	1,725	195	22	250	156
2020	Circuit376	-	-	-	-	-	-	-	-
2020	Circuit377	1,063	3,762	1,297	2,041	63	948	1,755	922
2020	Circuit379	2,068	2,152	2,146	2,122	1,068	1,199	2,031	1,433
2020	Circuit381	2,683	3,919	375	2,326	87	404	743	411
2020	Circuit382	2,030	3,111	1,249	2,130	814	569	1,710	1,031
2020	Circuit1744	-	-	-	-	-	-	-	-
2020	Circuit1748	665	1,432	1,311	1,136	1,584	652	1,569	1,268
2020	Circuit1750	1,185	225	1,109	840	1,392	2,273	1,870	1,845
2020	Circuit1751	2,971	2,012	3,324	2,769	1,978	914	78	990
2020	Circuit485	1,189	5,035	328	2,184	1,274	1,260	1,736	1,423
2020	Circuit486	270	-	-	90	-	-	-	-
2020	Circuit488	415	3,577	427	1,473	1,015	921	3,431	1,789
2020	Circuit491	1,450	5,683	1,205	2,779	907	985	210	701
2020	Circuit493	1,572	4,079	213	1,955	1,697	304	6,900	2,967
2020	Circuit494	1,104	2,788	1,537	1,810	280	985	254	506
2020	Circuit496	28	-	-	9	-	3	-	1
2020	Circuit497	3,241	2,457	1,565	2,421	290	664	186	380
2020	Circuit498	5,384	1,761	606	2,584	2,426	1,278	2,679	2,128
2020	Circuit499	1,074	1,744	245	1,021	1,226	946	630	934
2020	Circuit500	2,008	1,961	2,620	2,196	841	992	1,145	993
2020	Circuit501	988	493	2,752	1,411	57	2,227	1,670	1,318
2020	Circuit502	839	736	490	688	3,638	1,200	550	1,796
2020	Circuit503	721	1,743	1,076	1,180	316	1,592	918	942
2020	Circuit504	49	3,489	463	1,334	1,350	1,026	1,270	1,215
2020	Circuit505	175	223	1,320	573	1,184	438	109	577
2020	Circuit506	898	2,269	4,102	2,423	1,577	1,645	2,186	1,803

Michigan Public Service Commission

DTE Electric Company

Discovery Response: U-21534 MNSCDE-3.6-01

4.8kV Hardening Data

U-21534 MNSCDE-3.6-01 4.8kV Hard

Sum 2018-2020	15,970,299	19,429,219	15,302,011	16,900,510	5,453,370	3,814,416	7,694,814	5,654,200

Year	Circuit	Ex-MEDs CMI							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2018	Circuit2509	194,025	124,674	9,402	109,367	14,154	18,139	21,753	18,015
2018	Circuit814	118,911	273,564	155,721	182,732	76,708	10,534	48,685	45,309
2018	Circuit816	119,670	180,027	178,238	159,312	101,003	20,057	5,670	42,243
2018	Circuit1860	57,779	49,103	200,409	102,430	4,220	3,348	1,581	3,050
2018	Circuit1861	120,925	148,555	555,725	275,068	62,476	67,574	22,220	50,757
2018	Circuit3249	117,982	32,678	101,069	83,910	22,233	14,464	30,573	22,423
2018	Circuit1863	154,603	80,131	48,965	94,566	29,831	56,544	46,905	44,427
2018	Circuit1865	238,766	180,896	226,072	215,245	24,816	16,156	23,992	21,655
2018	Circuit1867	79,545	94,147	650,417	274,703	82,621	48,828	57,693	63,048
2018	Circuit1869	485,088	225,256	331,942	347,429	90,551	94,064	82,102	88,906
2019	Circuit1608	402,606	87,009	1,592	163,736	101,541	11,781	11,813	41,712
2019	Circuit1610	358,237	575,480	79,101	337,606	331,459	30,015	16,872	126,115
2019	Circuit1612	300,959	373,337	385,799	353,365	169,319	47,668	194,468	137,152
2019	Circuit1613	6,834	-	-	2,278	-	-	-	-
2019	Circuit1614	149,281	1,647,832	72,777	623,297	49,157	23,253	17,973	30,128
2019	Circuit1615	120,530	180,939	22,904	108,124	83,189	12,564	23,809	39,854
2019	Circuit1616	209,493	85,552	302,451	199,165	184,775	9,086	28,560	74,141
2019	Circuit1617	149,321	379,546	114,571	214,479	122,419	30,760	194,566	115,915
2019	Circuit1618	185,904	217,835	114,777	172,839	133,548	62,860	87,634	94,681
2019	Circuit813	71,644	359,128	48,956	159,909	11,699	22,993	23,775	19,489
2019	Circuit815	169,652	508,954	58,057	245,554	6,509	14,319	474,983	165,270
2019	Circuit817	121,256	656,362	186,013	321,210	22,549	140,856	254,949	139,451
2019	Circuit818	124,837	183,618	47,553	118,669	27,673	47,162	139,570	71,468
2019	Circuit2510	290,931	166,394	155,938	204,421	82,398	309,948	9,343	133,896
2019	Circuit819	7,387	33,229	33,783	24,800	126,523	32,986	10,437	56,649
2019	Circuit2511	922,305	331,319	200,052	484,559	12,453	7,158	143,462	54,357
2019	Circuit2512	108,232	288,065	162,727	186,341	13,504	5,806	200,313	73,208
2019	Circuit374	210,736	477,123	638,751	442,203	119,403	27,879	29,471	58,918
2019	Circuit1864	129,164	680,299	1,096,899	635,454	40,193	102,009	334,589	158,930
2019	Circuit1866	16,092	111,661	381,585	169,779	148,421	2,296	114,476	88,398
2019	Circuit1868	112,143	115,329	1,087,338	438,270	19,186	751,996	316,069	362,417
2019	Circuit1881	-	-	-	-	-	-	-	-
2019	Circuit1882	240,308	227,936	82,146	183,463	53,691	64,059	87,099	68,283
2019	Circuit1883	176,931	68,461	40,053	95,148	76,086	16,302	118,663	70,350
2019	Circuit3325	129,393	29,683	300,292	153,123	49,274	2,406	7,506	19,728
2019	Circuit3326	236,558	23,024	176,030	145,204	98,239	23,540	27,966	49,915
2019	Circuit1884	28,702	76,773	32,621	46,032	39,992	14,280	195,176	83,149
2019	Circuit1885	416,003	24,875	317,156	252,678	125,364	2,972	6,446	44,927
2019	Circuit1886	12,375	16,328	40,493	23,065	25,831	14,878	7,998	16,236

Year	Circuit	Ex-MEDs CMI							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2019	Circuit3327	54,109	26,744	16,718	32,524	73,359	154,361	58,331	95,351
2019	Circuit487	41,501	53,847	202,649	99,332	11,201	18,234	121,075	50,170
2019	Circuit489	57,786	123,234	667,953	282,991	19,321	6,164	304,959	110,148
2019	Circuit490	88,083	51,528	108,068	82,560	79,417	27,279	9,552	38,749
2019	Circuit492	27,756	227,345	429,794	228,298	78,829	14,137	157,547	83,504
2019	Circuit495	37,916	19,332	206,915	88,054	17,368	4,181	23,784	15,111
2020	Circuit1609	333,404	98,733	38,268	156,802	12,103	19,954	51,690	27,916
2020	Circuit55	1,698,543	73,768	92,549	621,620	30,336	22,420	36,298	29,685
2020	Circuit56	12,958	116,543	97,597	75,699	45,993	108	49,029	31,710
2020	Circuit57	224,573	60,695	87,738	124,335	19,174	2,177	61,990	27,780
2020	Circuit58	20,506	1,074,622	53,225	382,784	30,935	18,026	29,858	26,273
2020	Circuit60	503,241	458,918	48,281	336,813	45,072	105,871	448,624	199,856
2020	Circuit61	-	-	-	-	-	-	-	-
2020	Circuit62	219,996	75,271	79,715	124,994	8,362	13,831	37,769	19,987
2020	Circuit63	265,119	614,399	419,080	432,866	46,951	69,260	766,477	294,229
2020	Circuit64	247,192	223,587	102,724	191,168	31,410	59,478	108,083	66,324
2020	Circuit375	230,726	149,844	134,413	171,661	6,500	5,058	36,593	16,051
2020	Circuit376	-	-	-	-	-	-	-	-
2020	Circuit377	101,774	317,806	49,537	156,372	12,414	2,239	89,971	34,874
2020	Circuit379	75,511	296,758	304,637	225,635	14,950	11,358	79,449	35,252
2020	Circuit381	239,415	308,412	41,202	196,343	10,204	40,361	86,716	45,760
2020	Circuit382	30,935	563,842	220,611	271,796	27,168	105,235	105,733	79,379
2020	Circuit1744	-	-	-	-	-	-	-	-
2020	Circuit1748	30,209	34,563	184,129	82,967	145,335	6,324	47,838	66,499
2020	Circuit1750	102,897	11,988	309,996	141,627	183,627	218,531	33,559	145,239
2020	Circuit1751	464,529	59,252	234,555	252,779	183,144	19,737	16,050	72,977
2020	Circuit485	55,872	449,126	50,985	185,328	43,166	213,783	189,640	148,863
2020	Circuit486	116,948	-	-	38,983	-	-	-	-
2020	Circuit488	50,134	220,020	141,121	137,092	47,898	10,927	138,085	65,637
2020	Circuit491	264,632	1,012,584	241,935	506,384	7,526	57,457	24,470	29,818
2020	Circuit493	61,062	494,800	20,595	192,152	39,440	39,198	482,578	187,072
2020	Circuit494	132,364	278,974	91,269	167,536	24,379	9,420	114,066	49,288
2020	Circuit496	16,090	-	-	5,363	-	-	-	-
2020	Circuit497	635,114	190,843	135,450	320,469	18,255	14,769	26,253	19,759
2020	Circuit498	566,889	128,836	65,971	253,899	755,794	11,469	232,877	333,380
2020	Circuit499	419,182	467,304	77,505	321,330	21,394	25,272	58,146	34,937
2020	Circuit500	379,779	457,199	697,834	511,604	13,816	56,637	17,857	29,437
2020	Circuit501	310,133	110,879	94,586	171,866	6,028	108,690	82,372	65,697
2020	Circuit502	150,157	101,571	65,504	105,744	70,913	22,452	39,912	44,426
2020	Circuit503	446,507	80,822	51,164	192,831	23,767	36,166	40,431	33,455
2020	Circuit504	34,799	851,443	28,264	304,835	35,376	16,610	21,166	24,384
2020	Circuit505	52,915	67,316	230,284	116,838	379,622	32,892	15,725	142,746
2020	Circuit506	73,935	161,349	540,815	258,700	49,814	32,806	31,101	37,907

Michigan Public Service Commission

DTE Electric Company

Discovery Response: U-21534 MNSCDE-3.6-01

4.8kV Hardening Data

U-21534 MNSCDE-3.6-01 4.8kV Hard

Sum 2018-2020

1,413

1,719

1,741

1,624

1,178

1,258

861

1,099

Year	Circuit	Wire Down							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2018	Circuit2509	17	15	14	15	0	10	24	11
2018	Circuit814	30	17	18	22	9	15	17	14
2018	Circuit816	23	11	16	17	33	11	16	20
2018	Circuit1860	3	5	9	6	4	5	5	5
2018	Circuit1861	17	19	34	23	27	16	30	24
2018	Circuit3249	13	11	16	13	12	7	6	8
2018	Circuit1863	14	13	15	14	13	6	15	11
2018	Circuit1865	18	14	44	25	14	10	16	13
2018	Circuit1867	19	12	23	18	10	20	27	19
2018	Circuit1869	33	15	34	27	15	7	12	11
2019	Circuit1608	5	9	17	10	14	11	18	14
2019	Circuit1610	32	52	57	47	26	24	21	24
2019	Circuit1612	15	26	42	28	29	30	30	30
2019	Circuit1613	0	0	0	-	0	0	0	-
2019	Circuit1614	17	24	40	27	8	14	20	14
2019	Circuit1615	17	23	30	23	14	11	16	14
2019	Circuit1616	6	6	19	10	6	9	1	5
2019	Circuit1617	9	21	35	22	17	21	23	20
2019	Circuit1618	18	13	29	20	14	19	16	16
2019	Circuit813	8	12	6	9	9	8	17	11
2019	Circuit815	17	21	15	18	35	12	12	20
2019	Circuit817	17	19	29	22	12	15	20	16
2019	Circuit818	11	24	22	19	30	8	7	15
2019	Circuit2510	10	21	21	17	22	7	5	11
2019	Circuit819	7	15	17	13	11	15	13	13
2019	Circuit2511	12	34	11	19	8	8	6	7
2019	Circuit2512	17	11	12	13	12	9	6	9
2019	Circuit374	22	37	48	36	31	19	17	22
2019	Circuit1864	19	29	44	31	18	15	16	16
2019	Circuit1866	7	14	27	16	9	5	12	9
2019	Circuit1868	10	30	25	22	13	18	9	13
2019	Circuit1881	0	0	0	-	0	0	0	-
2019	Circuit1882	19	29	43	30	15	32	17	21
2019	Circuit1883	17	37	25	26	7	13	10	10
2019	Circuit3325	21	14	26	20	3	15	8	9
2019	Circuit3326	14	16	16	15	14	19	13	15
2019	Circuit1884	7	15	11	11	17	21	12	17
2019	Circuit1885	11	13	22	15	4	14	8	9
2019	Circuit1886	7	14	4	8	9	5	5	6

Year	Circuit	Wire Down							
		3 yrs. before	2 yrs. before	1 yr. before	3 yr. avg before	1 yr. after	2 yrs. after	3 yrs. after	3 yr. avg after
2019	Circuit3327	30	14	25	23	12	20	15	16
2019	Circuit487	12	27	50	30	11	19	16	15
2019	Circuit489	15	28	34	26	13	11	19	14
2019	Circuit490	26	24	33	28	22	11	13	15
2019	Circuit492	19	24	37	27	11	18	10	13
2019	Circuit495	19	12	13	15	11	20	25	19
2020	Circuit1609	22	21	18	20	21	8	3	11
2020	Circuit55	31	33	25	30	15	28	8	17
2020	Circuit56	12	14	16	14	10	16	4	10
2020	Circuit57	15	21	12	16	8	3	4	5
2020	Circuit58	5	22	7	11	5	6	4	5
2020	Circuit60	29	35	22	29	23	33	8	21
2020	Circuit61	0	0	0	-	0	0	0	-
2020	Circuit62	20	18	18	19	12	18	7	12
2020	Circuit63	70	40	58	56	24	25	7	19
2020	Circuit64	27	32	24	28	18	37	10	22
2020	Circuit375	14	27	10	17	18	4	5	9
2020	Circuit376	0	0	0	-	0	0	0	-
2020	Circuit377	17	29	17	21	20	12	5	12
2020	Circuit379	32	34	34	33	19	30	12	20
2020	Circuit381	37	34	27	33	15	18	14	16
2020	Circuit382	24	43	24	30	24	17	12	18
2020	Circuit1744	0	0	1	0	0	0	1	0
2020	Circuit1748	19	19	10	16	10	7	4	7
2020	Circuit1750	11	10	15	12	17	8	4	10
2020	Circuit1751	16	18	12	15	15	14	5	11
2020	Circuit485	25	42	18	28	55	16	6	26
2020	Circuit486	0	0	0	-	0	0	1	0
2020	Circuit488	46	42	30	39	17	17	7	14
2020	Circuit491	17	46	25	29	28	19	10	19
2020	Circuit493	28	36	13	26	13	19	7	13
2020	Circuit494	18	19	18	18	13	14	6	11
2020	Circuit496	0	0	0	-	1	0	1	1
2020	Circuit497	17	18	6	14	12	21	4	12
2020	Circuit498	31	21	28	27	18	24	13	18
2020	Circuit499	22	24	8	18	18	36	4	19
2020	Circuit500	9	22	17	16	21	34	8	21
2020	Circuit501	25	13	27	22	11	31	4	15
2020	Circuit502	24	19	20	21	26	25	13	21
2020	Circuit503	23	34	19	25	13	33	16	21
2020	Circuit504	16	30	25	24	12	16	6	11
2020	Circuit505	10	11	9	10	10	16	7	11
2020	Circuit506	21	52	20	31	12	50	7	23

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-15.24

Respondent: M. Elliott Andahazy

Page: 1 of 1

Question: 24. Refer to NDA U-21534 MNSCDE-3.10b-01 PTMM BCA Model. Refer to tab "Summary", please explain the values in column (J) BCA (Emergent Replacement Risk only) and Column (I) BCA (Emergent Reactive and Customer Outage Benefit). Explain at what value in these columns the Company will determine that action, i.e. spending as shown in column (G) "PTMM Investment" Scenario Life-Cycle Risk [2024 \$] is appropriate. Please provide details.

Answer: The Company considers circuits that have a BCA (Emergent Reactive and Customer Outage Benefit) score greater than 1 (column K in PTMM BCA Model.xlsm on tab "Summary") are appropriate candidates to perform PTMM work on.

Col J BCA (Emergent Replacement Risk Only) is the benefit in emergent replacement risk divided by the cost of the program for the individual circuits. Benefits in emergent replacement risk are quantified as the reduced costs incurred in emergent replacements.

Col I BCA (Emergent Reactive and Customer Outage Benefit) is the total benefit in both emergent replacement risk and customer outage risk, divided by the cost of the program for individual circuits. Benefits in emergent replacement risk are quantified as the reduced costs incurred in emergent replacements. Benefits in customer outage risk are the reduced economic costs associated with outages for our customers.

Attachment: N/A

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-12.5b

Respondent: M. Elliott Andahazy

Page: 1 of 1

- Question:** 5. Refer to Ms. Elliott-Andahazy's testimony at MEA 29:5, which states "Formerly called the Pole-Top Maintenance (PTM) Program, the modernization aspect was included in late 2019, and the program renamed to PTMM to reflect updated standards for inspection methods, and updated standards for equipment, and materials."
- b. Provide the proposal package presented to management that resulted in the approval of the updated standards referenced in the quoted statement. Include any workpapers accompanying the proposal to update the standards, including any cost and benefit estimates for the updated standards that may have been part of the proposal package.

Answer: The Company does not have a single proposal package that was presented to management that includes all the changes that were made to the PTMM program. Inspection and construction standards are analyzed, reviewed, and benchmarked periodically and changes are also triggered by a change in the National Electrical Safety Code (NESC). The Company has provided the prior inspection standards in responses to U-21534 MNSCDE-8.9b and current inspection standards as Exhibits A-23 Schedules M9 and M10.

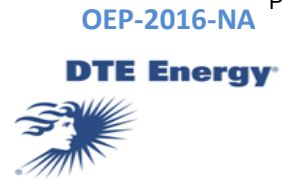
Please see attached files for examples the Company was able to locate with regards to analyses and presentations created by the Company's distribution engineering team and reviewed by distribution engineering leadership.

The Company wishes to clarify that the Pole Top Maintenance (PTM) Program was renamed in late 2019 to the Pole Top Maintenance and Modernization (PTMM) Program to reflect the changes in inspection methods implemented in 2019 as well as the changes implemented for construction standards prior to 2019.

Attachment: U-21534 MNSCDE-12.5b-01 Pole Standards
U-21534 MNSCDE-12.5b-02 Pole Standards Presentation
U-21534 MNSCDE-12.5b-03 Pole Inspection Standards Presentation



Engineering - OEP Report

**Report Topic:**

Cost impact due to minimum class3 pole and Grade B construction changes

Event Date:

N/A

Report Date:

May 6, 2016

Recipients:

DO

Author:

[REDACTED]

Problem Statement

In 2015 DTE Electric changed the construction standards to require the use of minimum class 3 poles and Grade B construction for the distribution system. The costs associated with these changes weren't fully evaluated, thus having an impact on the accuracy of project cost estimates and proper budget allocations.

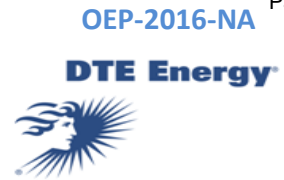
Summary

DTE is mandated by MPSC to have the electric system designed and built in compliance with 2012 National Electric Safety Code (NESC). The NESC minimum requirement is Grade C for distribution and Grade B for subtransmission.

The 2015 DTE changes to minimum class 3 poles and Grade B construction for distribution is an effort to harden the electric system. These changes will typically result in poles being increased two to three classes. The cost increase due to the 2015 changes is \$210 (additional material cost) and \$181 (additional labor cost) per pole for planned work (Grade B) and \$125 (additional material cost) per pole for maintenance, trouble and pole replacement work. For an average use of 5,500 poles per year for planned work the additional cost increase for material is \$1,155,000 and \$995,500 for labor for a total of \$2,150,500. For a total use of 4,500 poles for trouble, maintenance and pole replacement work, the annual material cost increase will be \$562,500.



Engineering - OEP Report



Overall annual cost increase due to these changes is approximately \$2,713,000 or 25% (based on estimated \$10,835,296 annual expense to buy and install 10,000 poles – does not include cost to install equipment on poles).

Background Information

The 2015 changes in the construction standards for DTE were targeting the hardening of the system and positioning ourselves for potential 2017 NESC changes that could require a higher grade of construction. At the same time, benchmarking with Midwest Energy Distribution Exchange (MEDE) revealed that 9 out of 14 utilities in the Midwest design their distribution system to Grade B standards, DTE not being one of them.

A. For trouble, maintenance and pole replacement type work, the change was to replace class 4 and 5 poles to a minimum class 3 pole (rule of thumb since design is not being done for this type of work). For planned work the change was to use the proper safety factors and design to Grade B construction requirements (typically with poles being increased by three classes and guying strength requirements being doubled).

A 2014 study report from the OEP group (["Increase minimum class pole"](#)), identifies that DTE has approximately 10,000 new poles that are installed annually for maintenance, rebuilds, new lines and trouble work. The incremental material cost for purchasing class 3 pine and cedar poles in 40', 45' and 50' lengths instead of class 4 or class 5 poles and replacing 40' poles with 45' poles will be approximately \$125 per pole ([based on 7 years average use](#)) while labor installation cost will be the same.

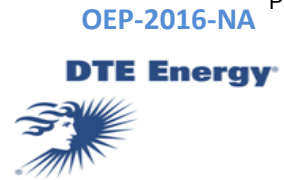
B. The change from Grade C construction to Grade B construction will require the use of higher safety factors when sizing poles and guying (for Heavy Loaded Tension Rule 250B – the Combined Ice and Wind Grade C factor is 2.06 while for Grade B the factor is 3.85). As a result, stronger poles will have to be used for the same construction details, usually an increase of 3 classes for the same span length (study done at 200' span lengths).

For the purpose of cost calculations, the following assumptions were made:

- No cost impact on the poles less than 35'
- Minimum 45' to be used for distribution primary



Engineering - OEP Report



- Grade B implementation will require mostly the use of class 1 and class 2 poles
- Assumed up to 8 additional poles per mile (shorter span lengths) to be able to use max class 1 poles
- Guying will have to be doubled

The incremental cost increase per pole due to Grade B construction will be approx. \$210 ([\\$178 pole and \\$32 guying](#)) for material and \$181 (\$30 to account for additional poles and \$151 for guying) for labor ([see the annual usage excel spreadsheet for more details](#)). The cost estimates are based on 3 phase construction and are direct costs.



DTE Energy®

Wood Poles Class Upgrade Overview

Presentation to EE Leadership

March 26th , 2015



Purpose of Project

**DTE Energy®**

- ❖ Strengthen System by using minimum Class 3 wood poles in Primary Distribution
- ❖ Position DTE for meeting future NESC requirements
- ❖ Align DTE with other utilities per benchmarking

Wood Pole Strength by Class



Eliminating class 4 and class 5 poles in favor of class 3 poles will provide incremental strength improvements for nearly 5000 pole locations per year

<u>Pole: Species, Length & Class</u>	<u>% Increase in strength at groundline</u>
<u>40Ft Tall, Pine</u>	
Class 3 (Reference)	
Class 4	20%
Class 5	45%
<u>45Ft Tall, Pine</u>	
Class 3 (Reference)	
Class 4	20%
Class 5	47%
<u>40Ft Tall, Cedar</u>	
Class 4 (Reference)	
Class 5	64%
<u>45Ft Tall, Cedar</u>	
Class 3 (Reference)	
Class 4	20%

Wood Pole Cost



The incremental cost for purchasing class 3 pine and cedar poles in 40', 45' and 50' lengths instead of class 4 or class 5 poles will be approximately \$420,000 annually given current pricing (18% cost increase).

<u>Pole: Species, Length & Class</u>	<u>Final Price Delivered Consignment</u>	<u>Average Usage 2008-2012</u>
<u>40Ft Tall, Pine</u>		
Class 3 (Reference)	\$ 243	146
Class 4	\$ 214	862
Class 5	\$ 184	620
<u>45Ft Tall, Pine</u>		
Class 3 (Reference)	\$ 282	726
Class 4	\$ 251	4,622
Class 5	\$ 218	2,184
<u>40Ft Tall, Cedar</u>		
Class 4 (Reference)	\$ 454	783
Class 5	\$ 366	399
<u>45Ft Tall, Cedar</u>		
Class 3 (Reference)	\$ 719	31
Class 4	\$ 508	1,293

The pricing is based on current demand, one thing to keep in mind is that as demand goes up for these larger sizes the risk of the cost going up due to potential shortages 4

Stakeholders

**DTE Energy®**

OH Standards has informed and consulted the following groups:

- ❖ Lighting Group: [REDACTED]
- ❖ Planning & Design: [REDACTED]
- ❖ IT: [REDACTED]
- ❖ Lines: [REDACTED]
- ❖ Supply Chain, Procurement: [REDACTED]
- ❖ Vendor-managed Inventory: [REDACTED]
- ❖ Wixom Pole Yard: [REDACTED]
- ❖ PTM: [REDACTED]

Challenges



Stock Transition

- ❖ 1800 poles in the yard, class 4 & 5 (Could cost up to \$100,000 to transition stock)
- ❖ Space Availability at Wixom
- ❖ Potential for short term stock shortage due to vendor pole plant fire in Nov. 2014

Future cost increase due to market demand (natural not manufactured product)

Tools for Planning:

- ❖ CU available in the system (IT: [REDACTED])
- ❖ Spec Book Updates (can be completed after transition)

Guidelines for Storm, Trouble, New Construction

Next Steps



DTE Energy

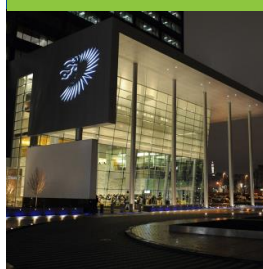
1. Ready to issue the Engineering Bulletin
2. Complete Compatible Units (CU)
3. Update Spec Book
4. Develop Guidelines for Storm, Trouble, New Construction
5. New pole types (composite, steel, concrete)



DTE Energy®

Wood Pole inspection/reinforcement/replacement overview

February, 2018



Changing pole inspection and replacement criteria can move DTE to a best in class model that lowers risk


DTE Energy®

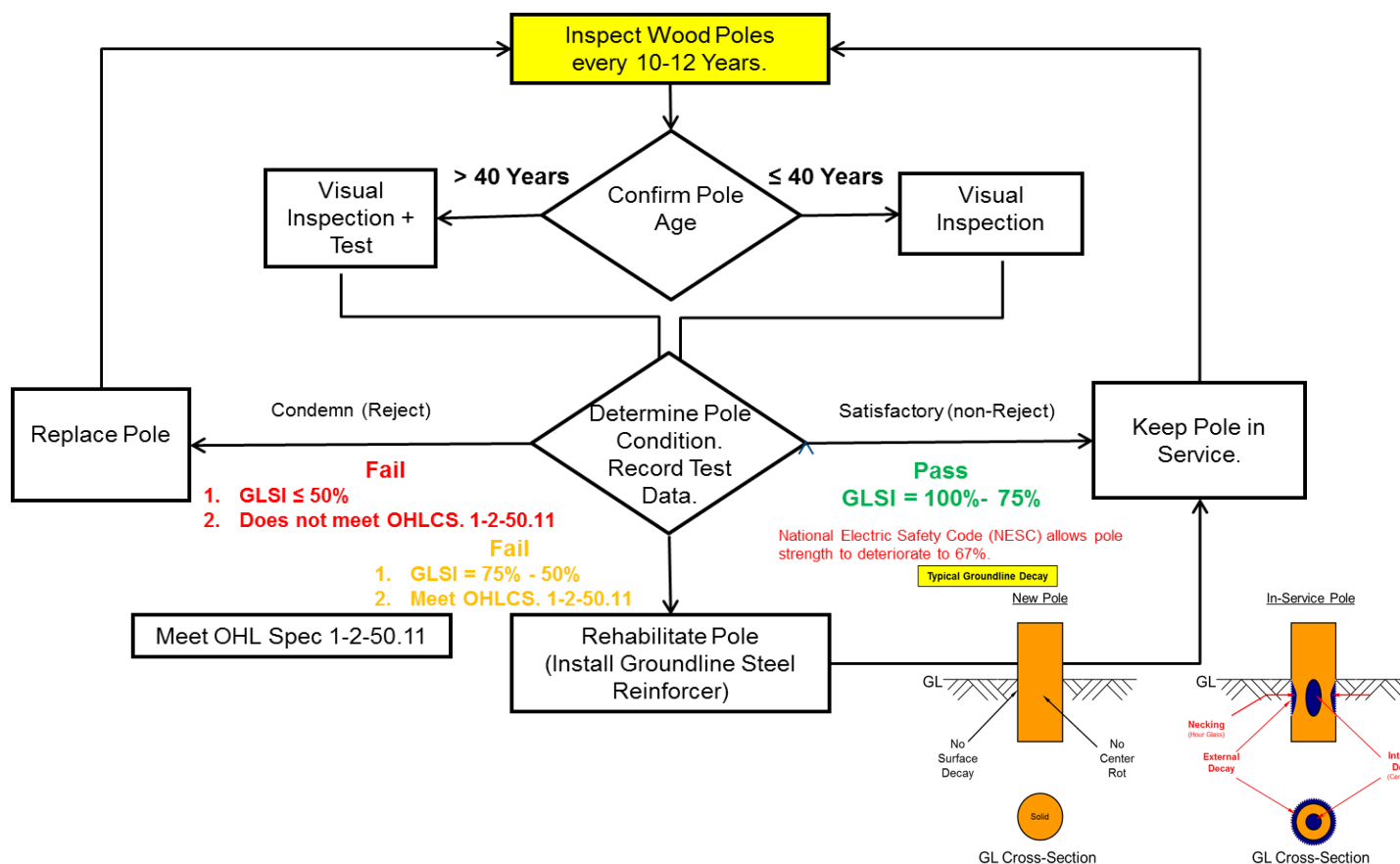
Comparison of Recommended Criteria to Past Criteria

	2015 Criteria	2016-2017 Criteria	Recommendation	Driver
Visual Inspection vs. Test	Visual: 10-25 yrs Test: >25 yrs	Visual: 10-40 yrs Test : >40 yrs	Visual: 0-10 yrs Test : >10 yrs	Benchmarking recommends a visual cutoff at 10 yrs
Rejection Criteria	Less than 67% strength	Less than 75% strength	Less than 67% strength	Industry recommendation (NESC ¹)
Reinforcement Rejection	No lower boundary as long as it meets reinforcement criteria	Between 50-74% strength & meets reinforcement specs	Between 15-66% strength & meets reinforcement specs	Industry benchmark
Replacement Rejection	All remaining rejections	All remaining rejections	All remaining rejections	
Defective Equipment	61 equipment types would have been replaced/repared if the budget allowed	16 of 61 equipment types are replaced/repared	48 of 61 equipment types will be replaced/repared	Safety
Retreatment	No	No	Yes	Industry benchmark

⁽¹⁾ National Electric Safety Code

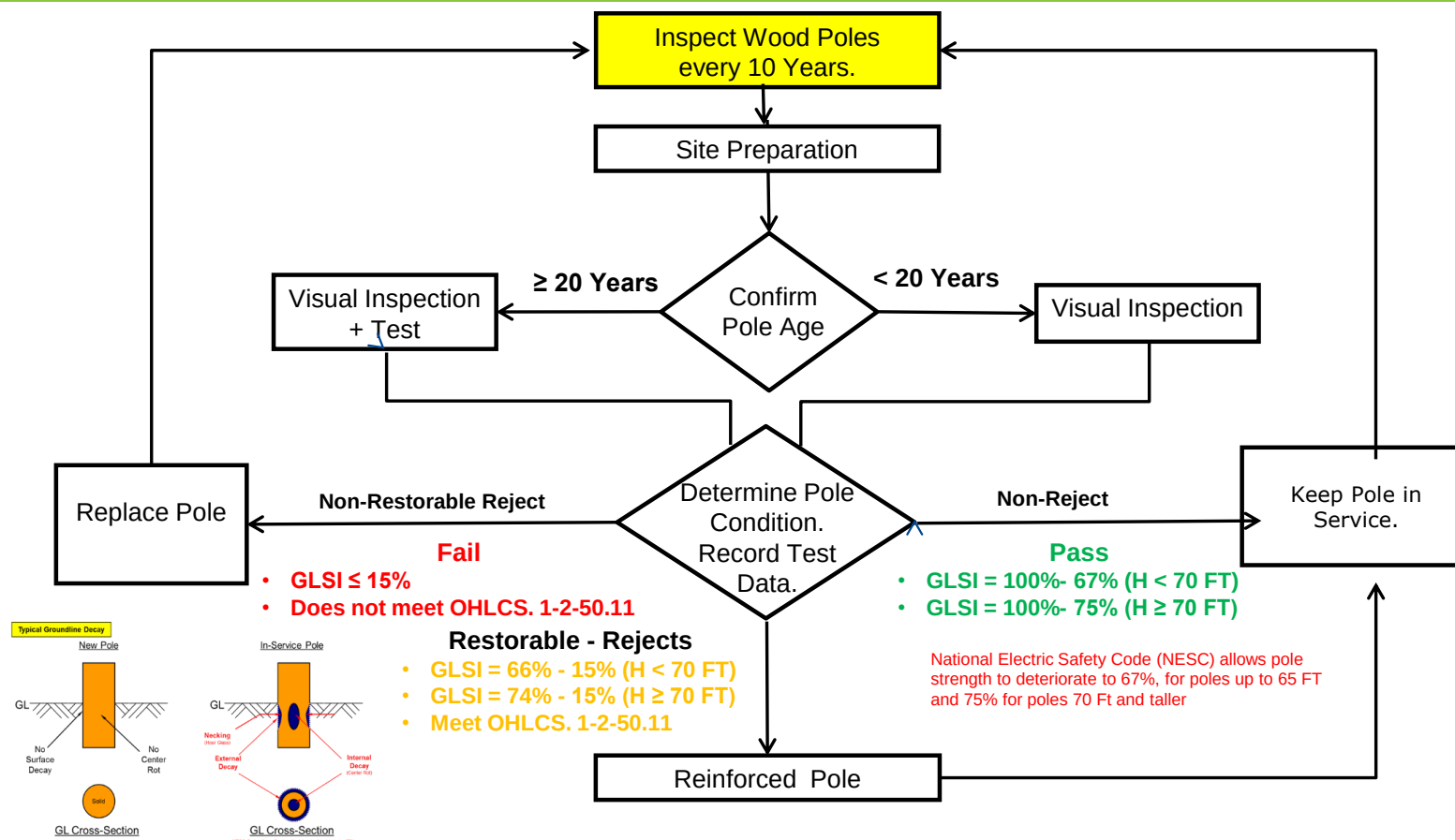

DTE Energy

2016-2018 Wood Pole Inspection Process



2018 Wood Pole Inspection Process – Pilot

2019 Wood Pole Inspection Process


DTE Energy


MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-12.5c

Respondent: M. Elliott Andahazy

Page: 1 of 1

- Question:** 5. Refer to Ms. Elliott-Andahazy's testimony at MEA 29:5, which states "Formerly called the Pole-Top Maintenance (PTM) Program, the modernization aspect was included in late 2019, and the program renamed to PTMM to reflect updated standards for inspection methods, and updated standards for equipment, and materials."
- c. Provide the results of all pilots completed on the PTM or PTMM programs that were employed or considered to help establish cost and benefit estimates for the proposal packages provided in response to subpart (b) above. If no such pilots were completed, please explain why not.

Answer: The Company did not complete any pilots prior to updating the inspection or construction standards. However, the Company (and 26 other utilities) engaged in a 3-year research program with the Electric Power Research Institute (EPRI) which culminated in a Distribution Grid Resiliency report (<https://eprijournal.com/making-distribution-grids-stronger-more-resilient/>).

In addition, as stated in my testimony on pages MEA-32 through MEA-34, the standards were updated based on benchmarking, utility industry research, and SME knowledge.

Attachment: N/A

INFLATION AND ESCALATION BEST PRACTICES FOR COST ANALYSIS

ANALYST HANDBOOK



OFFICE OF THE SECRETARY OF DEFENSE

**COST ASSESSMENT
AND PROGRAM EVALUATION**

DECEMBER 2021

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1. Introduction

Increasing costs for defense acquisitions has long concerned officials in the Department of Defense.¹ In 1958, Secretary of Defense Neil H. McElroy observed cost increases emanating from three interrelated sources: fewer production orders within programs; large technological advances between programs; and wage and price increases of defense resources. But what proportion of that cost change is attributable to fewer production units bought and thus less productivity achieved? What proportion is attributable to increasing the capabilities of submarines from diesel to nuclear power, and the subsequent addition of ballistic missile capabilities? What proportion of the cost change remains un-attributable to the previous sources?

When defense analysts attempt to estimate the cost of systems, they are chiefly concerned with understanding the cost effects of defense decisions. These decisions come in two broad forms: what to buy and how much to buy. To properly estimate the cost of a new system, the analyst needs to understand the relationships among historical costs, technical characteristics, and quantity orders. In order to derive realistic relationships, and ultimately estimate the final cost, the analyst will have to account for the effects of persistent underlying cost changes that occur regardless of individual programmatic decisions, specifically inflation and escalation. This handbook will help analysts use price indices to both estimate realistic program costs as well as to present those costs in a way that facilitates decision-making.

This handbook supersedes the prior OSD CAPE publications, “Inflation and Escalation Best Practices for Cost Analysis” (April 2016) and “Inflation and Escalation Best Practices for Cost Analysis: Analyst Handbook” (January 2017).

¹ Other observers have made note as well. In *An Inquiry into the Nature and Causes of the Wealth of Nations* (1776), Adam Smith wrote: “... the art of war, too, has gradually grown up to be a very intricate and complicated science.... Both [military] arms and their ammunition are become more expensive. A musket is a more expensive machine than a javelin or a bow and arrows; a cannon or a mortar than a balista or a catapulta. The powder which is spent in a modern review is lost irrecoverably, and occasions a very considerable expense. The javelins and arrows which were thrown or shot in an ancient one, could easily be picked up again, and were besides of very little value. The cannon and the mortar are not only much dearer, but much heavier machines than the balista or catapulta, and require a greater expense, not only to prepare them for the field, but to carry them to it.”

A. Background and purpose

A weapon system's cost depends in part on price changes in the broader acquisition process and external market economy. Well-researched forecasts of price changes help the Department of Defense (DoD) make sound acquisition trade-offs and adequately budget for the development, procurement, and sustainment of defense systems.

To illustrate, suppose DoD plans to procure a certain aircraft five years in the future. If an analyst assumes that the current aircraft price of \$100M will grow at the forecasted economy-wide inflation rate of about 2 percent, DoD would budget \$110M per aircraft for the procurement. But if there is reason to believe that prices for the aircraft industry will instead escalate at 3 percent annually, the unit cost² would grow from \$110M to \$116M. This unanticipated growth above budget could force DoD to buy fewer aircraft, accept unattractive compromises to schedule or quality, or to reprogram funding. Additionally, the average unit cost of the aircraft in inflation-adjusted constant-year dollars, for the year of procurement—the metric that Congress would track to assess DoD's management of the program—would also be higher than planned, \$105M versus the expected \$100M.

The above example shows the importance of considering price change in cost estimates, and introduces two types of price change: *inflation*, which is an economy-wide increase in the average price level, and *escalation*, which refers to changes in the prices of specific goods and services (including inflation). The difference between inflation and escalation raises several significant issues for cost analysis. In addition to understanding concepts and terms, analysts must be able to determine the most appropriate index for a given analysis. Many of the indices DoD publishes represent inflation only, so analysts may need to perform additional research to find appropriate escalation indices.

Section 3221 (formerly Section 2334) of Title 10, United States Code requires the Director, Cost Assessment and Program Evaluation (DCAPE) to “periodically assess and update the cost indexes used by the Department to ensure that such indexes have a sound basis and meet the Department’s needs for realistic cost estimation.” DCAPE published this handbook to help analysts meet these objectives. Developed in collaboration with cost estimators and economists in the Office of the Secretary of Defense (OSD) and the Military Services, the handbook provides best-practice guidelines for incorporating price change into cost analysis, and teaches analysts how to implement them. The escalation best practices are:

² Price is often defined as the sum of production costs and profit. This handbook will use the term cost for DoD purchases because profit is generally negotiated as a percent of cost for major systems.

- Adopt consistent terminology.
- Use realistic escalation rates to estimate costs in Then-Year dollars.
- Select long-term assumptions about fuel prices, military pay, and other rates to balance the realism and stability of estimates.
- Normalize inputs appropriately for use in cost estimating calculations.
- For external reports that support budgeting and decision-making, present cost estimates in Then-Year dollars (which represent the most complete and accurate forecast of costs) and Constant-Year dollars when comparisons are required or expected.
- Document and label all indices used in an analysis.

Analysts are expected to use this handbook's terminology and procedures appropriately. Cost estimates should incorporate the escalation rates that best forecast funding requirements for the system being estimated, taking specific markets into account. Cost analysts (and the organizations publishing estimates) are responsible for determining which escalation assumptions are appropriate and where they are applicable; for conducting analyses necessary to forecast escalation affecting system costs; and for developing the rationale for their approach. The cost community should foster the data and methods necessary to measure escalation affecting weapons systems, and encourage analysts to assess all escalation rates affecting their analyses.

B. Scope

This handbook focuses on the differences between inflation and escalation and their importance to cost analysis, and suggests methods of approaching cost problems in light of the various types of price change. This handbook is intended for the entire DoD cost analysis community: analysts in OSD, the Military Departments, the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Combatant Commands, the Office of the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, support contractors, and all other organizational entities within the DoD. The methods apply to costing all phases of a program's lifecycle and to all appropriation titles.

This document is organized by best practices. It starts with terminology and a framework for assessing escalation. Next, it provides advice for diagnosing input types and selecting desired output types for particular applications, such as Cost Estimating Relationships (CERs) and cost improvement curves. It also includes information on how to choose appropriate indices, as well as step-by-step instructions to complete basic and advanced calculations. Finally, it discusses common errors and sources of biases in inflation and escalation assumptions, and best practices for documentation.

C. Changes since the previous version

The previous versions of this handbook first introduced and justified the major terminology change of distinguishing inflation and escalation, as well as the definitions of real price change and constant price. Implementation of these concepts has been slow because their existence greatly increased the complexity of this subject, which expanded from two to five dollar types (then-year obligations, then-year expenditures, constant-year obligations, constant-year expenditures, and constant price) and from one to three types of price change (inflation, escalation, and real price change).

This version of the handbook expands on previous definitions and adds step-by-step instructions, aiming to increase the practical application of escalation and real price change across the cost estimating community. Some of the most significant changes for this version include:

- Added detail on the difference between obligations and expenditures (for both then-year dollars and constant-year dollars) and the definition of outlay profiles (Chapter 2)
- Expanded definition of constant price to differentiate between normalized data and modeling for forecasts (Chapter 2)
- Expanded definition of real price change to include quality and quantity changes, explanation of effects on cost models when difficult to isolate (Chapter 2)
- Added step-by-step instructions for basic calculations (Chapter 7)
- Added quick-reference flow charts (Chapters 4-6)
- Cancelled “base year dollars” as a formally recognized dollar type for cost estimates (Chapter 2)
- Differentiated between discrete modeling techniques for real price change versus modeling via indices (Chapter 3)
- Added instructions for how to assume a midpoint for multi-year inputs, or how to manually allocate multi-year inputs to single years (Chapter 7)
- Added concept of “transaction year” as distinct from “base year” (Chapter 2)
- Added instructions for making a custom index (Chapter 7)
- Added instructions for changing the base year of an index (Chapter 7)
- Added chapter discussing uncertainty: how to avoid mistakes and understand bias (Chapter 8)

This version of the handbook is considerably longer than its predecessor, and some readers may be discouraged when they see the page count. This handbook serves as a desktop reference, rather than as a set of instructions to be consumed in one sitting.

To digest this document in pieces, first read the definitions and framework description in Chapters 2 and 3, which provide the necessary theoretical basis for concepts associated with escalation. Then, from Chapters 4-6, use the following figures to make estimating decisions, referring to the surrounding text when you need to understand more of the theory behind the figures' recommendations:

- Figure 4-2: Flowchart to identify unknown input types ("Carrot Chart")
- Figure 5-1: Applications of various output types
- Figure 5-2: Output types at various points in cost estimating process ("Pitchfork Chart")
- Figure 6-1: Flowchart for selecting an index ("Nunchuck Chart")

Finally, apply the concepts from Chapters 4-6 when following the step-by-step instructions in Chapter 7, skim Chapter 8 to familiarize yourself with the information for future reference, and adhere to the documentation best practices in Chapter 9.

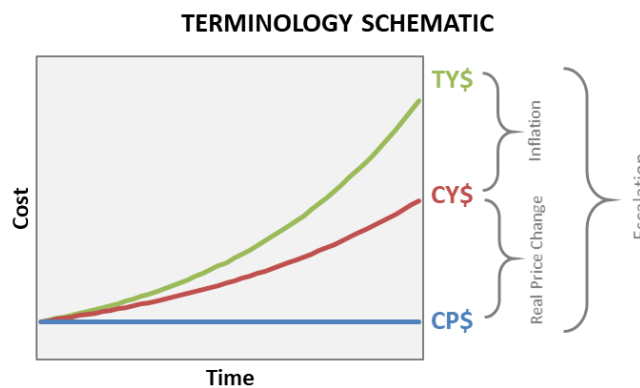
2. Terminology

This chapter will introduce the best-practice terminology used throughout this handbook. Chapter 3 supplements these definitions with a flexible framework that will help you apply them in real-world cost estimates. Appendix A contains a glossary with abbreviated definitions.

Figure 2-1 shows the primary terms covered in this chapter. Each line shows a type of dollars: then-year, constant-year, and constant price. The differences in price change content are labeled on the right: escalation, inflation, and real price change. Note that this graphic is a simplification to demonstrate the basic terms, and it does not cover all of the concepts presented in this handbook.³

Figure 2-1. Basic terminology.

This graph assumes positive real price change, which may not apply to all cost elements.



A. Inflation

Inflation refers to a rise in the general price level over time, which is an economy-wide average over all goods and services transacted. Inflation represents a decrease in the value of money (i.e., the dollar), due to an increase in the supply of money and credit relative to available goods, resulting in a rise in the general price level.⁴ Since money is on one side of every market transaction and is the unit of account against which the values of all other goods are measured, inflation affects all prices in the same proportion.

³ Some concepts that are not included in this graphic include the effect of outlay profiles (which would increase the y-intercept of the TY\$ and CY\$ lines and change their overall shapes slightly) and the interactive effect of inflation and real price change (which is an area of overlap between those labels on the right side).

⁴ The opposite trend of a decrease in the general price level is called deflation. Deflation is comparatively rare over a sustained period of time.

A rise in the general price level means that a given amount of money buys fewer goods and services.

Key to the definition of inflation is that it measures the *economy-wide* change in price as opposed to the change in price of any specific good or service.⁵ The inflation index used in Federal budgeting is the Gross Domestic Product Chain-Type Price Index,⁶ known more commonly as the GDP Price Index and abbreviated in this handbook as the GDPPI. The Bureau of Economic Analysis (BEA) of the Department of Commerce develops the index based on value-added prices of all final goods and services (sometimes referred to as a “market basket”) produced on US soil. It includes investment goods, consumption goods, services, and products exported overseas. The BEA also calculates the GDP Implicit Price Deflator, which is extremely close to the GDPPI but differs in its technical details.

B. Real price change

While inflation affects all prices in the same proportion, prices for specific goods and services may change at different rates due to real price change (sometimes abbreviated RPC). Positive real price change indicates that the item has become more expensive relative to an economy-wide basket of goods and services, whereas negative real price change indicates it has become relatively less expensive. The label “real” in real price change refers to the fact that it is measured in inflation-adjusted dollars, also known as “real dollars.”

The following examples of real price change are specific to particular markets, producers, consumers, goods, and services, thus distinguishing real price change from economy-wide inflation. For any good or service, real price change may include a combination of these and other forces depending on the context of the good or service within the economy over time.

- Market shifts
- Changes in the supplies of specific materials
- Changes to cost of doing business (e.g., overhead rates), for either contractors or the government
- Economies or diseconomies of scale
- Changes in the mix of the workforce, such as labor categories or skill levels
- Changes to inputs to production
- Rate effects and learning effects
- Technological change, such as increased automation of a production process

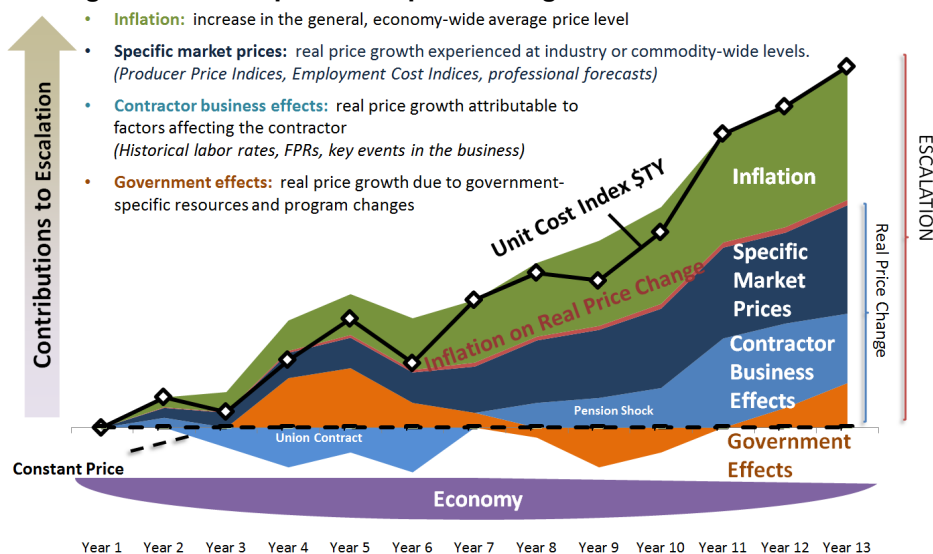
⁵ The Office of Management and Budget (OMB) Circular A-94 defines inflation as “the proportionate rate of change in the general price level, as opposed to the proportionate increase in a specific price.”

⁶ OMB Historical Tables and OMB A-94.

The inclusion of several of the items on the list above may surprise some DoD cost estimators, particularly rate effects, learning effects, and overhead rates. These types of real price change are often major research topics in the creation of cost estimates, but are not generally modeled in the same way as inflation. However, just because a cost driver contributes to the real (i.e., inflation-adjusted) change in price of a weapon system does not mean it must be modeled as a compounding annual rate, as with inflation. Chapter 3 discusses the option to model certain types of real price change discretely when possible, as opposed to using indices to capture them in broader strokes.

Chapter 3 also provides guidance on analyzing and categorizing real price change at various levels of detail, as appropriate for any given estimate or portion thereof. For example, Figure 2-2 below breaks down real price change for a notional program into market-related prices (e.g., raw materials, labor), contractor business effects (e.g., change in business base, change in pension plans, geographic relocation, implementation of process improvements), and government effects (e.g., government-driven schedule changes, quantity changes).

Figure 2-2. Example of real price change and inflation in observed data.



Understanding historical real price change in detail will help you understand the cost drivers affecting your estimate, and may inform forecasted costs as well. It may be appropriate to assume that the forces driving historical real price change will apply in the future, even if the forecasted rate of change is different from the historical rate. If you are unable to find an index that forecasts future real price change for a commodity of interest, you should consider applying observed historical rates rather than omitting real price change altogether. A failure to account for real price change would underestimate costs if the rate of change is positive, or overestimate costs if it is negative.

To measure the full extent of real price change present in historical data, normalize for inflation and then measure the remaining variation in costs over time as shown in Figure 2-3. You may also be able to decompose the total observed rate of real price change into discrete forces, as discussed in Chapter 3, if sufficient information is available. Analyzing real price change at this granular level of detail may help you communicate specific cost drivers and risks to decision makers.

C. Escalation

Escalation is the combined effect of inflation and real price change, as defined in the previous two sections. Some other terms that may refer to escalation include price change, market price change, specific price change or growth, and price escalation. These terms are somewhat ambiguous and may mean different things to different people. Always confirm content and definitions when discussing escalation with others because these definitions are often misunderstood or misapplied.

Escalation may be positive, negative, or zero; since inflation is usually positive in a growing economy, the direction of escalation depends primarily on the magnitude and sign of real price change (see Appendix C for graphics). Escalation may also be equal to inflation in two cases: the market basket may be so broad that it approximates the entire economy (which, by definition, experiences inflation only), or the market basket experiences no real price change relative to the economy as a whole.

A cost analyst may consider how the economy affects escalation for weapon systems. For example, changes in the unemployment rate are likely to affect the rate of change of defense workers' wages and salaries. Also, exchange rates can have relatively volatile effects on prices in foreign-based supply chains. For example, if the currency of a foreign supplier were depreciating, making the dollar-value of the materials cheaper, your analysis should consider how this factor affecting prices will behave in the future. You are not expected to make detailed forecasts of unemployment, labor productivity, exchange rates, or other economic factors, but you are encouraged to think about how this information can help explain past escalation or predict future unit cost changes.

Inflation and real price change (RPC) are multiplicative rates, which yields the following equation for escalation. Express the rates of change as decimals for use as multipliers: for example, 1.02 represents a +2% change over the time period (usually comparing Year X to Year X+1), 0.98 represents a -2% change, and 1.00 represents no change.

$$\text{(Rates as Decimals):} \quad \text{Escalation} = \text{Inflation} \times \text{RPC}$$

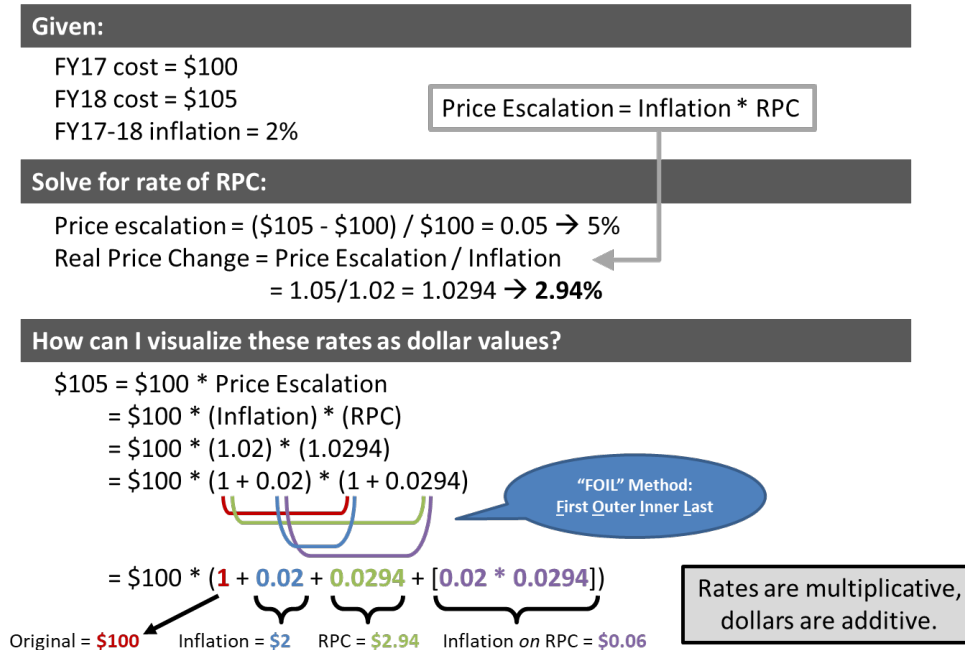
The multiplicative relationship shown above applies only to the decimal form of the rates—when shown in terms of additive dollars instead, an interaction term appears in the equation:

(Dollars): Escalation = Inflation + RPC + Inflation on RPC

For example, if a cost element experiences inflation at 2.00% and real price change at 2.00%, the escalation rate will be 4.04%. The additional 0.04% is the interaction term, or inflation *on* the real price change.

The example in Figure 2-3 shows the origination of this interaction term. Only calculate this term separately when attempting to estimate or display escalation as the sum of its parts. For example, you may apply real price change as a discrete rate separately from inflation for a given cost element, and want to show the independent dollar impact of each force on the total cost.

Figure 2-3. Multiplicative and additive relationships of conversions.

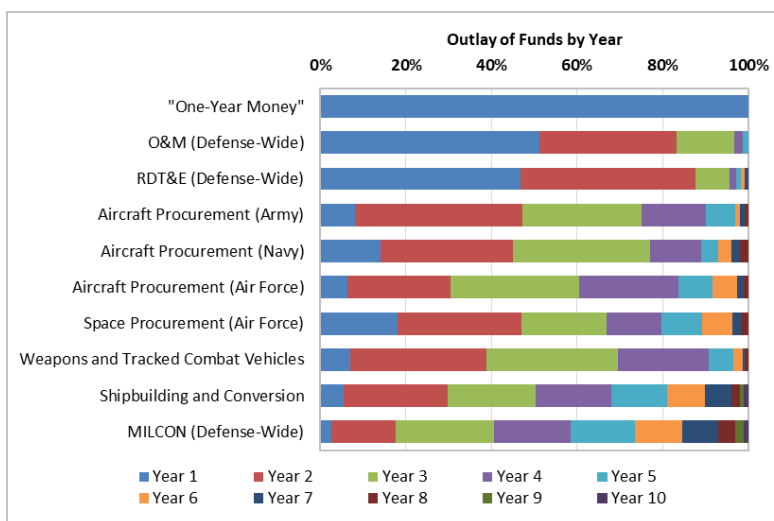


D. Then-Year dollars (TY\$) and outlay profiles

Then-Year dollars, often called “nominal dollars” beyond the DoD, are the most easily understood of the dollar types discussed in this handbook: they have real-world significance, as in the dollars you would actually use to purchase a good or service at the time of the transaction. Such dollars have not been normalized, and reflect the purchasing power at the time the transaction is recorded. There are two types of TY\$ in the federal environment—obligations and expenditures—which represent different types of transactions.

Obligations (“TY\$ obs”) are TY\$ that often represent budgeted values, and are recorded prior to the disbursement of funds from the US Treasury—even by as many as 10 years depending on the appropriation. The timing pattern in which funds are expended is an **outlay profile**, usually expressed as a percentage of funds expended per year (see Figure 2-4 for examples). By the time funds actually leave the Treasury to pay for a budgeted good or service, the dollar value of the good or service may have changed relative to its dollar value at the time of obligation (e.g., increased due to escalation). Obligations include an adjustment to account for this anticipated change in dollar value.⁷ Since most prices increase over time, this adjustment generally increases the amount in the obligation year to cover the actual funding required to be paid in the expenditure year(s). Note that some appropriations (e.g., military or civilian pay, fuel) are for “one-year money,” meaning that they are fully expended in the year of obligation or have an outlay profile of 100 percent in the first year; in such cases, obligations are equal to expenditures.

Figure 2-4. Outlay profiles for select appropriations, from FY 2020 President’s Budget Green Book.



Expenditures (“TY\$ exp”) are another type of TY\$, and represent dollars at the time they leave the US Treasury to pay a bill. Unlike obligations, expenditures do not experience a time delay and therefore do not need outlay profiles to adjust for anticipated changes in value. Expenditures for all appropriations function as though they have an outlay profile of 100 percent in the first year.

The difference between TY\$ exp and TY\$ obs becomes important when selecting indices for calculations, as described in Chapter 6. For calculations involving TY\$ obs, you must use **weighted indices** that account for the aggregate change in buying power over the course of the appropriation’s outlay period. For calculations involving TY\$ exp, you must use **raw indices**, which do not include an outlay profile. Raw and weighted indices may measure either the full rate of escalation or inflation only. See Chapter 7

⁷ See Chapter 6 section C for information on weighted indices, which apply this adjustment using outlay profiles, and Chapter 7 section E for instructions on making weighted indices.

section E for an example showing how to create a weighted index using a raw index and an outlay profile.

The next sections describe two other categories of dollars, each of which is the result of *normalization*. Keep in mind as you proceed that Then-Year dollars are NOT normalized relative to a point in time that differs from when they were or will be recorded – they have meaning in the real world and measure actual transfers of funds, whereas time-normalized costs have been adjusted for the purposes of estimating, comparing, or reporting.

E. Constant-Year dollars (CY\$)

Constant-Year dollars, often called “real dollars” beyond the DoD, have been normalized for inflation using an economy-wide index such as the GDPPI. A cost normalized to CY\$ is a counterfactual, measuring prices relative to a selected base year as though inflation were zero. Costs in CY\$ are “counterfactual” because they do not exist in the real world—you cannot go to a store in 2020 and pay for goods using dollars at their value in 2018’s economy. However, CY\$ are useful in cost reporting and comparisons because they remove a confounding variable (i.e., the changing value of money) from the subject of interest (e.g., weapon system costs).

This handbook recognizes, for the first time in DoD guidance, the existence of two different CY\$ types: CY\$ obligations (CY\$ obs) and CY\$ expenditures (CY\$ exp). The removal of inflation from TY\$ obs yields CY\$ obs, and the removal of inflation from TY\$ exp yields CY\$ exp. Although both CY\$ types include real price change, CY\$ obs also include the effect of the outlay profile on that real price change, while no outlay profile is present in CY\$ exp. There are very limited circumstances under which CY\$ exp are appropriate for use in cost estimating, as discussed in Chapter 5 section C; for almost all cost estimating tasks, you should calculate or use CY\$ obs instead of CY\$ exp.

Costs marked as CY\$ should include the year against which costs were normalized (the “base year,” see section H). Nomenclature is flexible as long as it is clear that it is constant-year dollars, and consistent within a given project; for example, a cost in FY 2025 normalized to CY\$ with a base year of FY 2020 could be represented as “CY20\$” or “CY\$, BY20” or “CY2020\$,” etc. Notice that none of these notations identify the costs as representing a transaction in FY 2025—although this is an important piece of information—only the base year (FY 2020) against which the costs are normalized. See section H for more information about referencing transaction years.

The next section on constant price also presents a counterfactual cost. The difference between these types of normalized dollars is the index used to produce them; by definition, a CY\$ must be created using an index that measures only economy-wide inflation. A constant price is the result of normalizing with an index that measures escalation.

F. Constant price (CP\$)

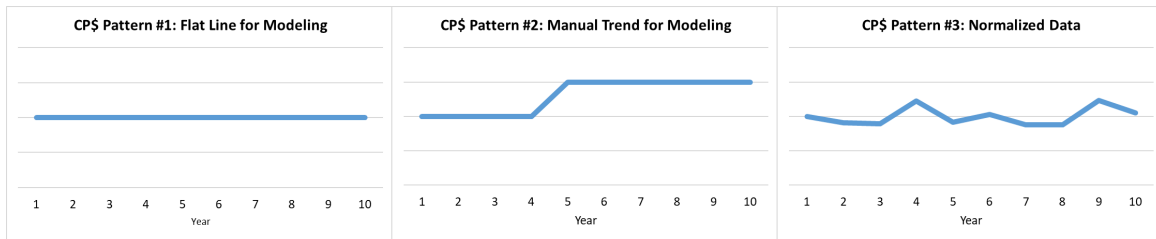
The term *constant price* refers to costs that, when expressed relative to a base year, do not include the effect of escalation (i.e., they include neither inflation nor real price change). This definition is somewhat idealized, as it is not always possible to remove all real price change (the exact value of which may not be known) when normalizing historical costs to CP\$. Do not let this ambiguity intimidate you, as it provides some flexibility in how you use CP\$ as a modeling tool—the estimating framework provided in Chapter 3 will help you work within these flexible boundaries of the definition of CP\$.

Costs marked as CP\$ should include the year against which costs were normalized (the “base year,” see section H). Nomenclature is flexible as long as it is clear that it is constant price, and consistent within a given project; for example, a cost in FY 2025 normalized to CP\$ with a base year of FY 2020 could be represented as “CP20\$” or “CP\$, BY20” or “CP2020\$,” etc. Notice that none of these notations identify the costs as representing a transaction in FY 2025—although this is an important piece of information—only the year (FY 2020) against which the costs are normalized. See section H for more information about referencing transaction years.

Unlike TY\$ obs and CY\$ obs, which are frequently used to express results to external customers of DoD cost estimates, CP\$ should only be used internally as a modeling technique or to understand historical trends. You should not generally present CP\$ in external reports unless doing so is required to explain the methodology used to reach your reported results in TY\$ obs or CY\$ obs, for reasons described in detail in Chapter 8 section C.

Constant prices are often visualized in training material as a flat line, but costs do not have to be equal in all years to represent CP\$. In fact, CP\$ may follow three general patterns when graphed over time, as shown in the notional examples in Figure 2-5 below. The first two patterns are used for modeling future costs (where the second reflects the impact of applying discrete cost estimating adjustments such as changes in quantity), while the third is the result of normalizing data with an escalation index.

Figure 2-5. Constant Price (CP\$) cost profile patterns.



- Pattern #1: value is equal for all years
- Pattern #2: value changes over time due to an identifiable trend⁸
- Pattern #3: value changes over time due to unknown or complex forces, either in historical or forecasted data⁹

For example, say a program office awards a contract for phone service at a total price of \$1.0M for the first year, Fiscal Year 2020 (FY20). The program office wants you to estimate the total cost for phone service for a ten-year period.

Your first step might be to model the costs using CP\$ Pattern #1, with a value of \$1.0M for each year. This model would apply the input data as a CP20\$ profile, in which costs are equal (at the FY20 price) for all years. Using the most literal interpretation of the words “constant price,” this pattern uses a completely static value over time.¹⁰ If the service contract is expected to be a fixed-price contract at \$1.0M per year for the full ten-year period, this CP20\$ profile would be equal to the TY\$ estimate. However, if you expect the provider to raise its service rates over time, you could convert the CP20\$ profile to TY\$ using a table of future rates from the provider, or a generic escalation index for telecommunications services from a publicly available source.

Alternatively, perhaps the program office tells you that it is going to increase its number of phone lines by 10 percent in the fifth year because of an expected increase in staffing. You might then create a CP20\$ profile like the one shown in CP\$ Pattern #2, with a jump in price due to a known change in the quantity of the item (here, the number

⁸ Chapter 3 will help you determine what types of trends are considered “identifiable,” generally anything you are modeling discretely in your estimate. Some examples include changes in number of items estimated, change in usage (e.g., flying hours, miles), learning effects, etc.

⁹ Note that this pattern may also be observed when data is normalized to CY\$. The distinguishing feature between CY\$ and CP\$ is not the “shape” of the resulting data, but the type of index used to produce the normalized cost profile: normalization via inflation indices produces CY\$, and normalization via escalation indices produces CP\$.

¹⁰ Prior to the previous version of this handbook (2017), the “flat line” representation of costs was referred to as Constant Year or Base Year dollars. In 2015, the DoD recognized that “Constant Year” dollars refer specifically to inflation-normalized costs (“real dollars” in classic economics terms), which may *not* be a flat line. For any commodities that experience escalation at a different rate than inflation, there is a divergence between what would be a flat line (CP\$) and inflation-adjusted costs (CY\$).

of phone lines). As long as the increase does not include *price* changes (such as service rates) relative to FY20, the line represents CP20\$ even though it is not entirely flat. To convert this CP20\$ profile to TY\$, you would apply price changes for each year using provider-specific rates or a more generic escalation index as described for Pattern #1 above.

Finally, you might decide to research historical data for the program office's communications services for comparison, and obtain records of similar contract expenditures (TY\$) for the past 10 years. You identify a relevant escalation index for telecommunications services (from the past provider or from a publicly available source) to normalize these historical costs to CP20\$. The normalized costs might look like CP\$ Pattern #3, in which there is inconsistent variation from year to year. The remaining variation is a result of factors not represented in the escalation index used for normalization (i.e., variables you are unable to normalize for), such as unknown changes in the quantity or quality of services during the historical period. If you used a generic telecommunications escalation index to normalize the costs, some of the variation may also be the result of provider-unique pricing changes that differed from those experienced by the broader telecommunications sector of the economy (as described by the index applied).

This example raises the question, "how do I know which index to use to de-escalate TY\$ to CP\$?" There is no easy answer in most cases, as the choice of index will depend on what you are estimating and how you are accounting for interrelated forces. Publicly available indices are useful tools for characterizing some causes of real price change, but there will be many other cost drivers that you could not—and would not want to—characterize with an escalation index alone. Chapter 3 provides a conceptual framework for understanding how escalation and real price change relate to other cost drivers, and Chapter 6 discusses index content.

When you obtain a result like CP\$ Pattern #3 for normalized data, you may want to further normalize the data depending on the trends you are trying to characterize (e.g., calculate cost per phone line to account for quantity changes, rather than using total contract cost alone). Economists who produce publicly available escalation indices often attempt to control for quantity and quality changes so that their indices represent pure price change; for example, an economist might track the price of a particular laptop over time, and manually adjust the index values to account for changes in the number of units purchased and any price-driving improvements in quality. For this reason, economists generally do not consider quantity and quality changes to be a type of real price change, contrary to this handbook.

The option of controlling for quantity and quality changes via indices as described above is often not available for DoD cost estimators, as we are unlikely to find publicly available indices that perfectly describe the quantity and quality changes of the weapon

systems or subsystems we are estimating. In fact, a primary feature of cost estimating is modeling those effects discretely through techniques such as learning curves and cost estimating relationships, which are described in other DoD cost estimating guidance. This handbook puts those techniques into context relative to escalation and inflation so you will know when and how to apply them, particularly in Chapters 3 and 5.

To review the concept of constant price, the following example shows how all three patterns of CP\$ could come into play in a single cost element. Adding onto the previous example, say your program office has asked you to estimate the travel budget for five years, FY21-25. You obtain historical expenditures (TY\$) for travel per employee, and locate an escalation index for generic travel prices from a publicly available source. You use this index to normalize the historical per-person travel costs to CP20\$, resulting in costs that follow CP\$ Pattern #3 from Figure 2-5. You notice that the CP20\$ costs have been relatively consistent for the past five years, with an average of \$10,000 per year. You use \$10,000 as a flat-line CP20\$ input (Pattern #1) to begin forecasting the costs for FY21-25. You then discover that upcoming program changes will require people to travel overseas more frequently starting in FY23; you decide to modify your flat-line profile of \$10,000 per year to include a 30% increase for FY23 and beyond (Pattern #2) to account for your assessment of the cost increase associated with international travel. Finally, you use an escalation index for travel prices (perhaps the same one you used for your initial normalization, if you think it is representative of future prices) to convert your CP20\$ profile to TY\$.

G. Cancellation of “base year dollars (BY\$)” as a dollar type

As of the publication of this handbook, “base year dollars (BY\$)” are no longer considered a valid dollar type. Cost estimators often use this outdated term to refer to either CY\$ or CP\$, but do not provide sufficient information (i.e., the index used to produce the value) to determine which of the two it represents. By using the terms CY\$ and CP\$ instead, cost estimators can easily identify the type of index used to produce each value, and make appropriate decisions regarding their use.

Although no longer valid as a dollar type, the concept of a “base year” is still relevant to the concepts in this handbook, as described in the next section. In short, a base year is a point in time against which costs are measured, and may apply to CY\$, CP\$, and indices themselves.

H. Transaction year vs. base year

The conversions described in this handbook manipulate the relationship between costs and time in order to study, forecast, or control for time-correlated pricing effects. These manipulations can seem abstract, and it can be difficult to articulate what a given cost represents after normalization. To better keep track of costs, this version of the

handbook introduces a new term (“transaction year”) and more explicitly defines an older term (“base year”) to better align with its use in the broader economics community.

Transaction year refers to the time at which an obligation is obligated or an expenditure is expended, depending on the type of data you’re using. All costs, regardless of whether they represent TY\$ from a primary source or have been normalized to CY\$ or CP\$, represent costs that occurred or will occur at this point in time.

When TY\$ costs are normalized to either CY\$ or CP\$, they take on an additional characteristic of a **base year** that does not apply to TY\$. While CY\$ and CP\$ retain their transaction year (i.e., the costs still represent that point in time), they are now measured relative to the base year of the index used to normalize them. In other words, they are restated in the dollar-units of the index base year—normalized for either inflation (CY\$) or escalation (CP\$), depending on the index type—but they still occur in the transaction year. For weapon system estimates supporting major decisions such as milestones, the year of the decision is often chosen as the “program base year” in order to have a consistent point of reference. The actual year selected does not impact the results, as demonstrated in Chapter 7 section F.¹¹

A failure to keep track of the transaction year when dealing with normalized costs can lead to inaccurate calculations when converting dollar types. For example, normalizing a TY\$ cost incurred in FY20 to CY18\$ (such as to compare to another program baselined to CY18\$) does not mean that the costs now occur in FY18; we are simply measuring the cost for FY20 (the transaction year) in terms of FY18 dollars (the base year). This distinction may seem like a minor issue of semantics, but can lead to errors in calculations and interpretation of results; Chapter 4 section D will explain the importance of this distinction when dealing with data representing a single year.

When you are ready to begin the conversion calculations described in Chapter 7 section A, you will need to specify a parameter called *Year_{in}* to identify the first index value required. The transaction year will be *Year_{in}* for TY\$ inputs, and the base year will be *Year_{in}* for CY\$ and CP\$ inputs.

I. Indices

An index is like a ruler that measures a given type of price change relative to a specified point in time. Most indices measure annual price change (e.g., calendar year, government fiscal year), though some measure changes by quarter or by month. The year

¹¹ You generally should not select a future year as a base year for your estimate, as the index values for future years are subject to change. Forecasted inflation and escalation are rarely perfectly accurate, so using a future base year will subject the entire estimate to that forecast error. Even using a past year as the base year can induce the same error if the full outlay period has not been completed, as any weighted indices used may include future years’ forecasted rates.

against which the index values for all other years are measured is called the “base year” of the index. You may use an index with a base year that matches your estimate’s base year, but it is not necessary to do so (see Chapter 7 section F for more information on base years as they relate to indices). There is also considerably more information on indices in Chapter 6. Note that some sources refer to indices as “deflators,” but that name does not necessarily mean that the index measures inflation only.

You may encounter indices that require manipulation before you can use them in your estimate. For example, some sources of labor escalation rates display salary by year instead of as a multiplier relative to the base year. To convert such an index for use in your estimate, select a base year and divide each year’s value by the base year’s value (this will create a series of multipliers with 1.0000 in the base year). Other sources may display year-over-year percentage changes, in which case you should follow the instructions for building indices as shown in Chapter 7 section D.

J. Terminology confusion and controversy

The terms “escalation” and “inflation” are often used interchangeably in casual conversation, but these terms have distinct definitions and confusing them can lead to misunderstandings. Figure 2-6 presents some examples of correct and incorrect terminology in selected cost scenarios; the preferred terms, as used in this handbook, are in **underlined bold**.

Figure 2-6. Examples of correct and incorrect terminology

What Happened	Examples of Correct Terminology	Incorrect Terminology
The price of medical procedures increased 3%	- Medical escalation <u>Escalation</u> - Price change - Specific price change	- Inflation - Medical Inflation
The general price level in the U.S. increased 1.7%	<u>Inflation</u> - General price inflation	- Escalation - Specific price change
Government civilian pay increased 1.5%	- Pay raise <u>Escalation</u> - Wage growth	- Inflation - Pay inflation - De-escalation
Excluding inflation, the price of material increased 3%	<u>Real price change</u>	- Material inflation - Material escalation - Escalation - Cost growth above inflation

The terms presented in this handbook, including the incorrect ones above, have evolved over time. Prior to 2015, there was no explicit differentiation between inflation and escalation in DoD cost policy, and the application of real price change was not a standard practice. There was some recognition of price-changing forces that differed from

inflation, leading to the creation of the term “cost growth above inflation” to ensure that all costs were captured; this term should no longer be used, as it has grown in scope to include forces other than real price change. The terminology as presented here was developed in 2015, and published in the previous versions of this handbook.

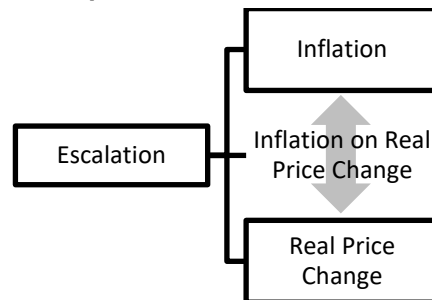
Some of the terminology used here has been tailored for use by the cost estimating community, which may make comparisons to general economics materials difficult. For example, the difference between obligations and expenditures is unique to Federal budgeting practices, economists refer to TY\$ as “nominal dollars” and to CY\$ as “real dollars,” and the concept of CP\$ is unique to cost estimating. Although the economics community provides the tools (indices) required to normalize historical data for escalation, CP\$ do not have a clear use case outside of a cost estimate (such as to use in a cost estimating relationship or to create an average cost factor across multiple years). The application of constant prices as the basis of forecasts is also a cost estimating-specific activity—the counterfactual of “prices remain constant in perpetuity” would not provide useful insights to an economist, but it is a useful modeling tool for cost estimators who apply forecasted escalation in later steps.

Because some of the terms presented in this handbook are unique to the cost estimating community, you may find information in other sources that appears to contradict this guidance. Please keep in mind that it will take some time for these terms and methodologies to be accepted and implemented across the cost estimating community, and that some sources that are not designed for cost estimators may not use these terms in the same way or with the same degree of differentiation and precision as required for accurate cost analysis.

3. Framework for Analyzing Escalation

All goods and services produced in the US economy are subject to the same overall rate of inflation, but the causes of real price change (and therefore escalation overall) may vary from one commodity to another. Cost estimates generally capture multiple commodities (e.g., types of materials, labor categories, etc.), meaning that different cost elements may be subject to different rates of escalation. Figure 3-1 provides a basic framework for understanding the relationships among these terms from Chapter 2, and notes the interactive term that accounts for the inflation that occurs on top of any cost increase or decrease due to real price change.

Figure 3-1. Simple escalation framework categories.



Ideally, cost analysts will be able to expand this simple framework by breaking out real price change into more detail. Identifying the forces that cause real price change within an estimate or portion thereof will help you understand key cost drivers, and select forecasts for future price change.

This chapter contains a framework that provides categories of real price change for you to consider as you complete your estimate. The framework was developed from a cost estimator's perspective, and relates real price change to specific analytical techniques that DoD cost estimators apply. Feel free to customize the framework categories as needed given the information you have for your estimates.

This framework is meant to be a conceptual guide—not a foolproof checklist—so think of it as a brainstorming aid. There may be some types of real price change discussed in this chapter that do not apply to your estimate, or additional types of real price change that are unique to your estimate. Use the ideas in this chapter to help you break down real price change into manageable pieces, use your best judgment to account for it as it applies to your estimate, and remember to always document your reasoning.

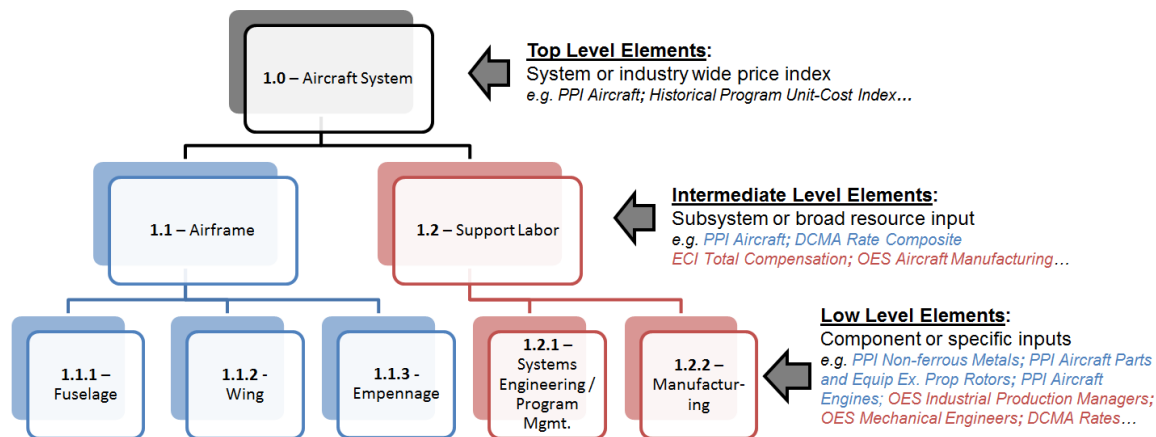
A. Framework scales to any level of detail

As you start to identify sources of real price change that apply to your estimate, keep in mind that you are not limited to evaluating real price change at the level of total

end-item cost. A weapon system is comprised of various subsystems, each of which can be further described by components, which contain smaller deliverable sets, etc. The Work Breakdown Structure (WBS) or Cost Estimating Structure (CES) you are using for your estimate, and the level of detail therein, may help you identify categories of costs that you want to treat as groups for escalation analysis. The best practice is to assess escalation at a detailed level when time and data permit.

The framework provided in the next section of this chapter can apply to all levels of cost detail. Figure 3-2 below shows a notional aircraft WBS with potential escalation indices that may be useful at each level. Instead of asking, “what part of the observed real price change is due to changes in aircraft prices at large?” you could ask, “what part of the observed real price change is due to price changes in the components or resource inputs to the aircraft?” For example, you might use a Producer Price Index (PPI) for aircraft to understand the market pressures affecting total aircraft system costs. At a lower level of the WBS, you could examine the PPI for aircraft engines, Employment Cost Index (ECI), Occupational Employment Statistics (OES) index, market data on engineering salaries, or other indicators of production cost. See Chapter 6 for guidance on selecting an escalation index suited to various levels of cost detail, and Appendix B for more information about the example indices used in Figure 3-2.

Figure 3-2. Analyze escalation at most appropriate WBS level



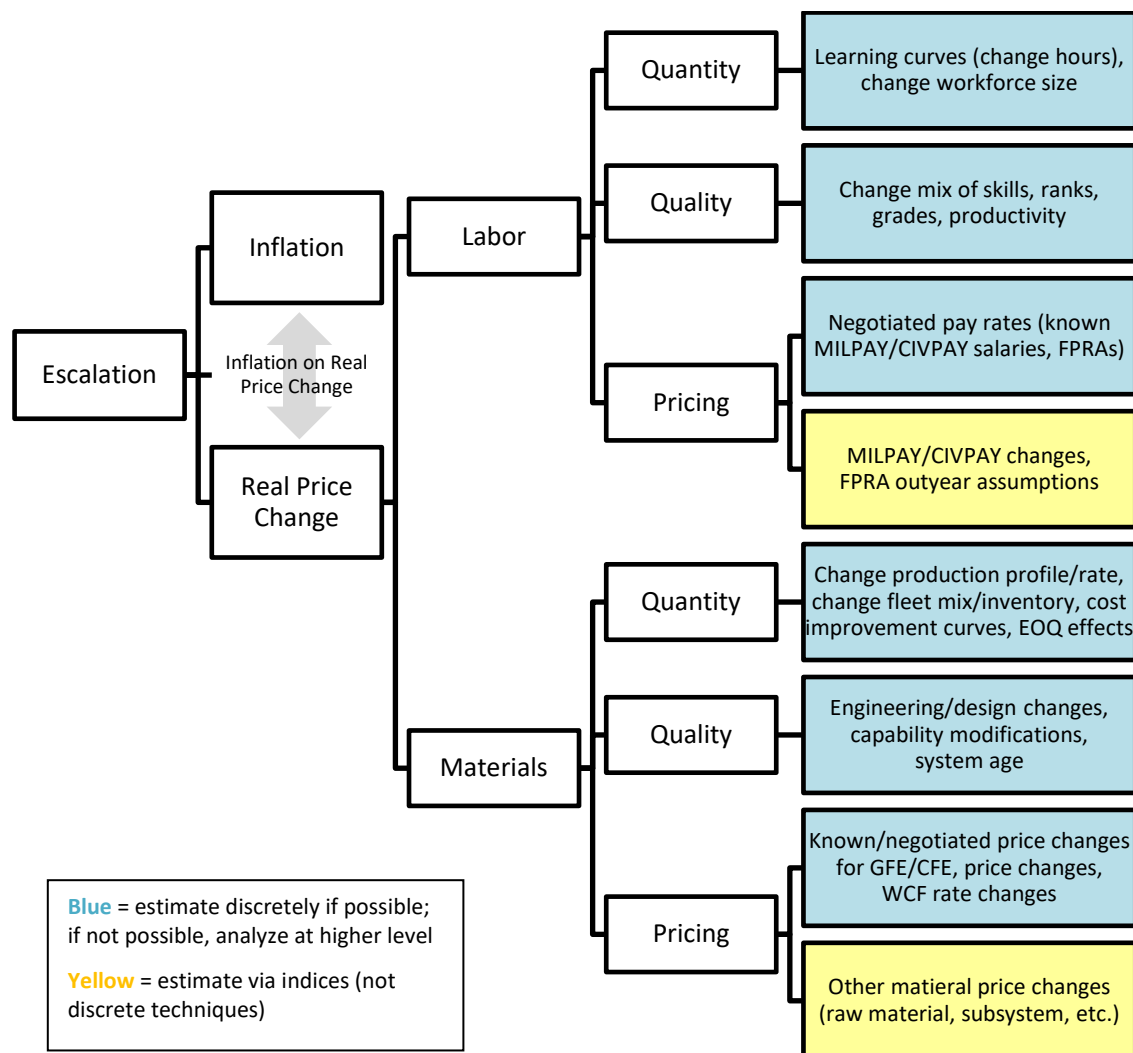
As an everyday example, say you just returned from the grocery store with your receipt and want to estimate what the same “market basket” of goods will cost at some point in the future. Looking at your receipt, you find that there are several ways you could categorize the items, such as produce vs. meat vs. packaged goods, organic vs. conventional items, by individual item, or even at the total level. You could analyze pricing trends for any of these categories depending on what is most useful for your grocery shopping decisions, or based on the availability of price index data for various categories. Likewise when estimating costs for defense items, you should break down the

costs into categories that are both useful for other estimating methodologies and well-suited for the application of available indices.

B. Cost estimator's framework for analyzing escalation

Figure 3-3 below presents categories of real price change under a cost estimator-oriented framework. The framework begins with the broad categories of labor and material, to align with common estimating practices. More specifically, goods or services within each of these categories may experience changes in quantity, quality, and/or pricing, causing costs to change over time. The forces described below may be positive, negative, or zero for any given estimate.

Figure 3-3. Cost estimator's framework for analyzing escalation.



1. Quantity changes

Any decision to change the quantity of a good or service estimated will affect its total cost, whether due to government effects (e.g., budget limitations), contractor effects (e.g., capacity limitations), or any other cause. Even on a per-item basis, changes to the total quantity estimated may induce price change due to rate-related effects like learning, productivity, and economies of scale.

Quantity changes are central to cost estimating, and rarely if ever appropriate to model via indices in the same way you would apply inflation. For example, if a program achieves a 10% savings in an input by purchasing an Economic Order Quantity (EOQ), the best way to model that change may be as a step function (e.g., price X until EOQ threshold achieved, then price X * 90% beyond EOQ threshold) independently of the application of generic price indices.

2. Quality changes

The weapons systems for which we estimate costs often evolve over time—for example, an estimate may include variants with different configurations or capabilities, or modifications for planned technological improvements. Some of these qualitative changes may affect costs, either positively or negatively, and we must account for this type of real price change in our estimates.

Some quality changes are easier to model than others. For example, you may be able to infer the quality of a labor hour from the skill level or grade of the worker assigned to complete it, but you may not know whether he or she performed well during that time. Similarly, it may be easy to estimate the cost impact of an engine upgrade if the new engine was a one-for-one, form-fit-function replacement of the previous engine, but difficult to quantify the cost impact of a software release that reduced the frequency of system errors.

Quality changes may be more difficult than quantity changes to estimate discretely, but they are equally important in assessing weapons system costs. You should account for known quality changes when possible, both to explain historical trends and to estimate planned changes in the future.

As discussed in Chapter 2, economists do not generally consider quantity and quality changes to be types of real price change because they have techniques to remove those effects when developing escalation indices. DoD cost estimators, however, are unlikely to find indices that perfectly account for those changes in the highly specialized commodities we estimate; rather, we may use quantity- and quality-adjusted escalation indices from external sources, then account for quantity and quality changes discretely in individual cost models. The framework in this chapter includes quantity and quality changes as a form of real price change to acknowledge the fact that the boundaries

between the categories may be blurred for some estimates (especially when little data is available to estimate real price change discretely) and to put those changes in context relative to publicly available indices so you can avoid double-counting or omitting important cost drivers.

3. Pricing changes

The final component of real price change in the framework is the only one that is inherently related to price: any changes to the cost of a product or service that cannot be attributed to quantity or quality changes. For example, a contractor may increase their overhead rates, causing the price to increase for a product or service that has not substantively changed since previous pricing periods. Another example would be an increase in the price of steel due to market-wide changes in supply and demand that are not related to your program of interest, and do not represent a change to the quantity or quality of steel in your estimate. In these examples, you may be able to discretely estimate the real price change impact if you have sufficient information from the contractor for the overhead rate change, or a price index representing market-wide changes in steel prices.

In many cases, however, you will lack sufficiently detailed data to account for such pricing changes discretely in historical data—in other words, you may observe real price change that you cannot definitively explain. For example, you may observe a clear upward trend in costs measured in CY\$, but not know the cause. In these cases, you may wish to look up an appropriate price index that is relevant to the product or service you are estimating, or measure the unexplained real price change (e.g., calculate the annual change in CY\$ costs, or look for trends in the timing of major price changes) and decide whether you think it will continue in the future.

4. Discrete estimating methods vs. indices

In deciding what types of real price change apply to your estimate (or any portion thereof), differentiate between price changes you can estimate discretely (blue boxes in Figure 3-3) and those you will estimate via indices (yellow boxes). It is generally preferable to use discrete estimating methods whenever possible because they are specific to your estimate, whereas indices that represent broadly defined content may be less appropriate for your estimate or include real price change already captured via discrete methods.

For example, say a particular labor category in your estimate is experiencing wage growth across the economy (i.e., for both DoD and other consumers). If you are already capturing DoD-specific wage increases for that labor category with a Forward Pricing Rate Agreement (FPRA, a discrete method), applying an additional price index for that labor category may double-count some or all of the wage growth you have already

included. Figure 3-5 below shows fictitious data from two possible data sources for a labor category's wages: an FPRA for the specific contractor represented in an estimate, and a generic, industry-wide price index for the same labor category.

Figure 3-4. Example: selecting real price change resources for contractor pay rates

Provided by Contractor		Generic Industry Index ¹²	
	FPRA		Index
Year 1	\$1,000 / man day	Year 1	1.000
Year 2	\$1,050 / man day	Year 2	1.030
Year 3	\$1,100 / man day	Year 3	1.061
Year 4	\$1,150 / man day	Year 4	1.093
Year 5	\$1,200 / man day	Year 5	1.126
Year 6+	Not provided	Year 6+	Continue 3% increase per year

In this example, you would use the FPRA for years 1-5 because it discretely estimates labor costs for the particular contractor in your estimate; there is no need to apply the generic escalation index because the FPRA already captures all of the growth in these labor costs. Alternatively, if the contractor did not have an FPRA, you could use the generic index for all years (i.e., there is not sufficient information to estimate labor escalation discretely, so estimate escalation via indices).

Notice that the rates of real price change are significantly different between these two options: the FPRA shows escalation at almost five percent per year, and the generic index shows escalation at three percent per year. Making comparisons like this could help you better understand your estimate, as you may wish to research the reasons for the contractor's divergence from industry averages. You may also consider this information in forecasting a rate of escalation for years further in the future; for example, if you apply the FPRA with approximately five percent escalation per year for Years 1-5, you may want to consider whether to use the industry-average index showing three percent escalation for subsequent years or continue the FPRA escalation rate for Year 6 and beyond.

The preceding example required a relatively straightforward decision between a single discrete method and a single index-based method; more often, you will have to

¹² See Appendix B for examples of the types of sources you may use to look up industry-wide indices like this.

decide among multiple options, and the lines between them may be blurry. For example, say you are estimating a program that consumes a large portion of the US market for a particular type of composite material. Some of your discrete estimating techniques, such as production rate, may substantially affect the demand for that material on the open market, and therefore its price—and consequently drive any price index you may be able to find for that composite material. If you apply a generic index for the material in your estimate, you could be double-counting some real price change due to the overlap between your estimate and the market(s) that are relevant to its content.

Distinguishing between discrete and index-based estimating for real price change is important, as *one of the greatest challenges in applying escalation in your estimate will be selecting indices that minimize the overlap with forces you are already estimating discretely*. The boundaries between these categories may be different for each estimate depending on the information available. Toward the goal of producing the most accurate cost estimate possible, you should be able to affirm that you have accounted for forecasted real price change in each element of your estimate, regardless of whether you modeled it discretely, via indices, or a combination of the two methods.

5. Applying the framework given incomplete or ambiguous information

This chapter's escalation framework lists many specific estimating techniques that may not be possible in every estimate or for every commodity analyzed. For example, you may not be able to discretely model quantity changes in labor costs if you know the total cost of a contract but not the number of hours worked. Even worse, you may know the total cost of a contract but not the relative proportions of labor and material costs within it, so the separate categories of Labor and Materials shown in the framework diagram would not apply.

When circumstances prevent you from analyzing escalation at the more detailed levels of the framework diagram, consider analyzing real price change at a higher level of the framework. You will lose granularity of the cost drivers, but may need to accept that limitation when you have insufficiently detailed information. If you measure total real price change at a higher level of the framework, you will capture the net effect of changes in quantity, quality, and pricing.

4. Characterizing Input Types

This chapter will provide guidance on characterizing cost estimate inputs, and will help you determine your “starting point” for the flowchart in Figure 6-1. Chapter 5 will help you decide the type of output you want for a given application, and Chapters 6 and 7 will help you select the indices and calculations required to convert the input to the output.

The dollar types represented in some data sources are easier to identify than others, depending on the consistency of the data collected, the purposes for which the data were collected, and the detail of the accompanying documentation. There are two sets of circumstances in which you may find yourself: (1) your input comes from a source that unambiguously dictates the input type and you must simply characterize it, or (2) your input comes from an ambiguous source and you must seek more information, filling in any gaps with educated assumptions.

Use this chapter as instructions whenever you find an input and are unsure how to use it. The first section describes the information you will need to obtain, and the second and third sections will help you find that information if the data is from a rigidly defined source (section B) or a more ambiguous one (section C). The final section provides additional guidance for dealing with data points that represent a single year, which involve some unique considerations.

A. Information required to understand an input

The following checklist is a preview of a more extensive documentation chapter (Chapter 9) at the end of this handbook. Ideally, you would be able to find all of the information shown in Figure 4-1 for every input value in your estimate, and you would document every output (including intermediate steps) in a similar fashion.

Figure 4-1. Attributes required to precisely characterize inputs and document results.

<u>DOCUMENTATION CHECKLIST</u>	
☐	Value
☐	Transaction year
☐	Dollar type (TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, CP\$)
☐	Base year (if CY\$ or CP\$)
☐	Index applied (if CY\$, CP\$, or future TY\$), including publication date

Example 1: \$100,000 was expended in FY 2014 in the “Aircraft Procurement, Air Force” appropriation.

- Value: \$100,000
- Transaction Year: FY 2014
- Dollar Type: TY\$ exp
- Base Year: N/A
- Index Applied: N/A

Example 2: An obligation in the “Aircraft Procurement, Air Force” appropriation was recorded in FY 2014, totaling \$22,000 in CY18\$, normalized using the “Aircraft Procurement, Air Force” weighted index, published January 2020.

- Value: \$22,000
- Transaction Year: FY 2014
- Dollar Type: CY\$ obs
- Base Year: FY 2018
- Index Applied: Aircraft Procurement, Air Force (weighted), January 2020

Given that most cost estimates are dense spreadsheets with many inputs in various years and appropriations, it would be cumbersome to list the above attributes in bullet format for every value. Instead, structure your cost estimates so that labels or section headers can document similar inputs simultaneously, or such that pieces of documentation like base years or dollar types can also serve as inputs to functions you will use (e.g., VLOOKUP, INDEX, and MATCH in Microsoft Excel). For example, you may enter the dollar type and reference year of an input near the value itself, and use those descriptive cells to look up the appropriate index value in a table elsewhere in the model. Similarly, you could create a column aligned with your estimate’s cost element structure that lists index names for each element, and use a look-up function to pull in the appropriate index values from references tables on another tab. This active documentation adds transparency for others who will review your estimate, improves efficiency of the model, and facilitates changes as you develop your estimate. See Chapter 7 section A for more advice on modeling practices.

When you are ready to begin the calculations listed in Chapter 7 section A, you will need to specify a parameter called *Year_{in}* to identify the first index value required. The transaction year will be *Year_{in}* for TY\$ inputs, and the base year will be *Year_{in}* for CY\$ and CP\$ inputs.

B. Inputs from well-defined sources

Any source that enables you to fully characterize an input according to the Documentation Checklist provided above is considered “well-defined” for the purposes of this handbook. These sources may be *primary sources*, such as accounting systems or

formal budget documents (which record costs in TY\$), or *secondary sources*, such as a well-documented cost estimate from another analyst (which could be in any type of dollar depending on the analysis).

Primary-source data is in TY\$ (either expenditures or obligations) because it represents real-world transactions that have not been altered for the purposes of calculations or comparisons. You should try to start with data from primary sources whenever possible so that you will know the details of every transformation executed, thus avoiding the uncertainty that comes with using previously-manipulated secondary-source data. Some common primary sources of cost data include:

- For TY\$ obs:
 - Budget documents
 - Acquisition Program Baseline (APB)
 - Selected Acquisition Report (SAR)
 - Air Force Total Ownership Cost (AFTOC)
- For TY\$ exp:
 - Cost and Software Data Report (CSDR)
 - Contractor Performance Report (CPR)
 - Invoices
 - Price lists (e.g., Federal Logistics record [FEDLOG], Army Price and Credit Table [APACT], Air Force D043)
 - Naval Visibility and Management of Operations and Support Costs (Naval VAMOSOC)
 - Operation and Support Management Information System (OSMIS)

Some of the above sources also offer costs normalized to CY\$ or CP\$ for convenience. You should avoid using these options when possible because using pre-normalized values as inputs can cause distortions if you don't know exactly how the values were produced. For example, the indices applied in a database or previous cost estimate may be out of date by the time you retrieve the values, and any calculations you perform using newer indices will include the effect of deltas between the indices. You may also find that systems with TY\$ exp data also offer CY\$ exp versions (rather than CY\$ obs), which are not ideal for cost estimate inputs. The impact of any distortions may be small, but could cause confusion when comparing results with those of another analyst who pulled the data from a different source or at a different time (see Chapter 8 section B for more information on the impact of using inappropriate or mismatched indices).

Starting with raw data from a primary source, you will likely perform multiple rounds of conversions prior to generating your final cost estimate—the output of each conversion will become the input of the next (see Figure 5-2). For example, you might retrieve TY\$ obs historical data from a primary-source database, de-escalate it to CP\$ to calculate an average factor across multiple years, escalate that factor to each year of the estimate for your TY\$ obs output, and then deflate those costs to CY\$ obs for a threshold report. Each of these steps treats the output of the previous step as the input of the next: TY\$ obs to CP\$, CP\$ averaged over multiple years (no dollar-type change occurs in this step), CP\$ to TY\$ obs, and finally TY\$ obs to CY\$ obs. Since you are doing each step in this process yourself, you can ensure that all indices include appropriate content and are up-to-date. As long as you correctly identify the desired output type for each step (as described in Chapter 5) and maintain good documentation (see Chapter 9) to keep track of what the value represents, you will minimize the potential for errors and bias in your results.

C. Inputs with missing or ambiguous identifying information

Cost estimators often have to use imperfect data in order to produce an estimate. This section will provide recommendations for investigating data that you cannot fully describe according to the instructions in the previous section.

First, there are two attributes of an input that you simply must know in order to use a value: the value itself, and the transaction year that puts it into context with respect to time. If you know neither how much money was or will be spent, nor the timing of the transaction, any further calculations to adjust for inflation or escalation will not provide a meaningful result.

If any of the other attributes listed in the documentation checklist (reproduced here) are unavailable, unclear, or untrustworthy, you should first attempt to get more information from the data source.

DOCUMENTATION CHECKLIST

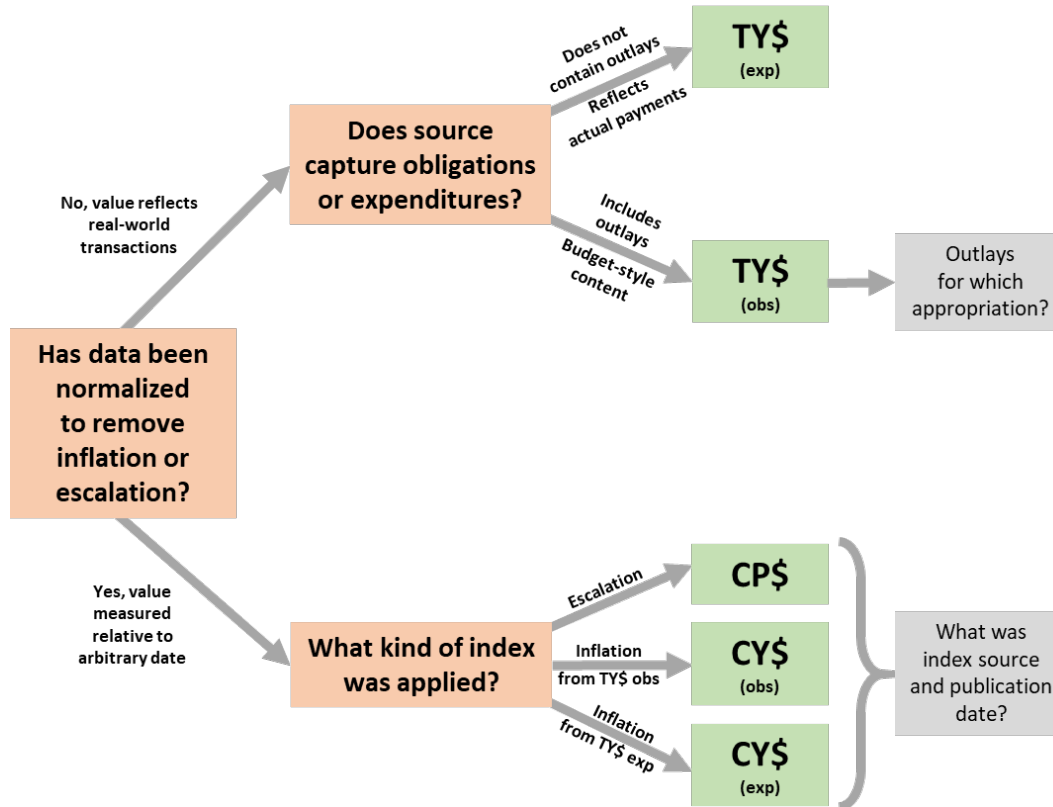
- ☐ **Value**
- ☐ **Transaction year**
- ☐ **Dollar type (TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, CP\$)**
- ☐ **Base year (if CY\$ or CP\$)**
- ☐ **Index applied (if CY\$, CP\$, or future TY\$), including publication date**

1. Questions to ask when clarifying data attributes

Many data sources label costs in ambiguous ways, or the label provided may not align with the best practices in this handbook. For example, you may find data that is not labeled at all, or that has labels like “2020 constant dollars,” “FY 2020 \$,” or “BY2020” that do not follow standard nomenclature. If you can find a point of contact that is

knowledgeable about the data, ask questions from the flowchart in Figure 4-2 from left to right until you are confident that you have fully characterized the input. The flowchart is a visual representation of the definitions provided in Chapter 2, so refer back as needed for more details. The gray boxes on the right include additional questions about indices involved in certain inputs, which will help you identify the indices to use in your own calculations (see Figure 5-2 and Chapter 6).

Figure 4-2. Flowchart to identify unknown input types (“Carrot Chart”).



2. How to make assumptions for unknown input attributes

When there is no way to obtain further information about an ambiguous input, ask yourself whether you truly need to use it or can obtain alternative data from a more reliable source. If you must use the input, make assumptions as needed to select an appropriate index value for calculations; use your best judgment, the advice of colleagues, and best-practice guides such as this one to inform your decisions, and make sure to document your actions and the reasons for your lack of confidence in the data. You may be concerned that decision makers will find your lack of faith disturbing, but a realistic understanding of risk is important for acquisition decisions. The dollar impact of any incorrect assumptions will likely depend on the period of time involved—for example, the potential for error will be greater in a conversion from 2005 to 2020 than in one from 2015 to 2020.

In the absence of any information that would suggest otherwise, this handbook recommends assuming that a cost with unknown attributes represents a TY\$ exp in the labeled transaction year. Subsequent calculations will induce a slight error if the cost actually represented TY\$ obs or CY\$ obs because they would neglect the effect of escalation or real price change, respectively, over the course of the outlay period.

D. Using single-year expenditures as CP\$ inputs

Although some inputs have well-defined attributes that dictate their dollar types and subsequent use in calculations, a useful shortcut for cost estimating allows you to treat TY\$ exp and CP\$ as equivalent in cost models. In a given transaction year, the value of a TY\$ exp is equal to its corresponding CP\$ value when normalized to that year (i.e., the base year is the transaction year). For example, an expenditure (TY\$) of \$100 in FY20 means the price in FY20 was \$100, or CP20\$ equals \$100. This relationship does not exist between TY\$ obs and CP\$, however, because the TY\$ obs value accounts for prices in later years as well (i.e., during the outlay period).

To demonstrate this input flexibility, say you are estimating government manpower costs for a unit. First you obtain FY20 salary data by rank and grade for all personnel types in the unit. A salary is a TY\$ value because it has real world significance: the amount will be transferred in a transaction between the employer and employee, and it has not been normalized to CY\$ or CP\$ using any indices. More specifically, you may treat these salaries as expenditures in FY20 because the value will be fully paid in that year.¹³ The typical process for estimating manpower costs is described below, and further notes will describe what is happening in each step in terms of escalation and inflation:

1. Obtain headcounts required for each year of the estimate, broken out by grade, rank, location, etc., as needed.
2. Obtain salary data (TY\$) for the current fiscal year (FY20 in this example), including grade, rank, location, special pays, etc., as needed.
3. Multiply headcounts for each year by corresponding salaries for the current fiscal year (FY20).
4. Escalate each year's manpower cost to the year of the estimate (TY\$) using an appropriate index for military pay, civilian pay, contractor pay, etc.

¹³ You may find that you should treat salaries as obligations in certain situations if some of the payments will cross fiscal years (i.e., follow an outlay profile into a second year). This point emphasizes the importance of knowing your data, but we will treat a salary as a one-year expense for the sake of the example presented.

5. Deflate each year's entry to the base year of the program (CY\$) using an inflation index for final reporting.

In step 2, you retrieved salary data that is best described as a TY\$ exp, as discussed previously. In step 3, you created a CP20\$ estimate for the headcounts included in the unit; this cost profile is CP\$ because the year-to-year variation in costs is due to changes in quantity (number of people) or quality (rank, grade, etc.) within the unit, but not due to any price changes (because the price is a constant FY20 salary based on type of person).¹⁴ In step 4, you turned the CP20\$ estimate into a TY\$ estimate for each year (transaction year), and then deflated the estimate to CY\$ in Step 5 for use in comparisons or reporting requirements.

What happened between Steps 2 and 3? You started with a TY\$ exp (salary) as your input and wound up with a CP20\$ profile, even though you didn't use any indices to convert from TY\$ exp to CP\$. In modeling situations like this, you are really treating the input as a CP20\$ value, which is permitted because a TY\$ exp in FY20 is the same when normalized to CP20\$ (the index value would be 1). The salary in FY20 is both a real-world value (TY\$) and a *constant price* throughout the year in the most literal interpretation of "CP\$."

This flexibility does not exist for inputs that are phased over multiple years. Although you could treat each year individually as a TY\$ exp, or CY\$ or CP\$ normalized to the base year of that transaction, there is no use case for doing so that is evident to the writers of this handbook. For example, if you obtained costs for FY18-FY20 from a database containing TY\$ exp, you could treat the FY18 costs as TY\$ exp in FY18, or as CY18\$, or as CP18\$... and you could treat the FY19 costs as TY\$ exp in FY19, or as CY19\$, or as CP19\$... and likewise for the FY20 costs, but the resulting collection of CY\$ and CP\$ in different base years is not easy to use in a cost model. Such values are effectively in different units of measurement, and cannot be combined in any calculations (see Chapter 8 section A). Rather, you would treat the FY18-20 data as TY\$ exp for each of those transaction years, and treat the data as a block for calculations; for example, you may normalize each year's value to CP18\$ using an escalation index so that the transaction years remain evident (i.e., you can still see how much was spent in each year), but they are all normalized to the same base year.

¹⁴ According to older definitions, the action in Step 3 would have been considered the creation of a "base year" or "constant year" profile, rather than CP\$ as presented here. The publication of this handbook has not changed the basic process of performing calculations such as these, in which you estimate costs using some "flat-line" profile (see Chapter 2 section F) and apply an index to produce TY\$. The changes in terminology since 2015 have simply clarified the fact that the index used to produce a TY\$ in this process should be an escalation index, and that an additional step of deflating that TY\$ estimate to CY\$ using an inflation index produces a unique output for reporting purposes.

5. Selecting Output Types

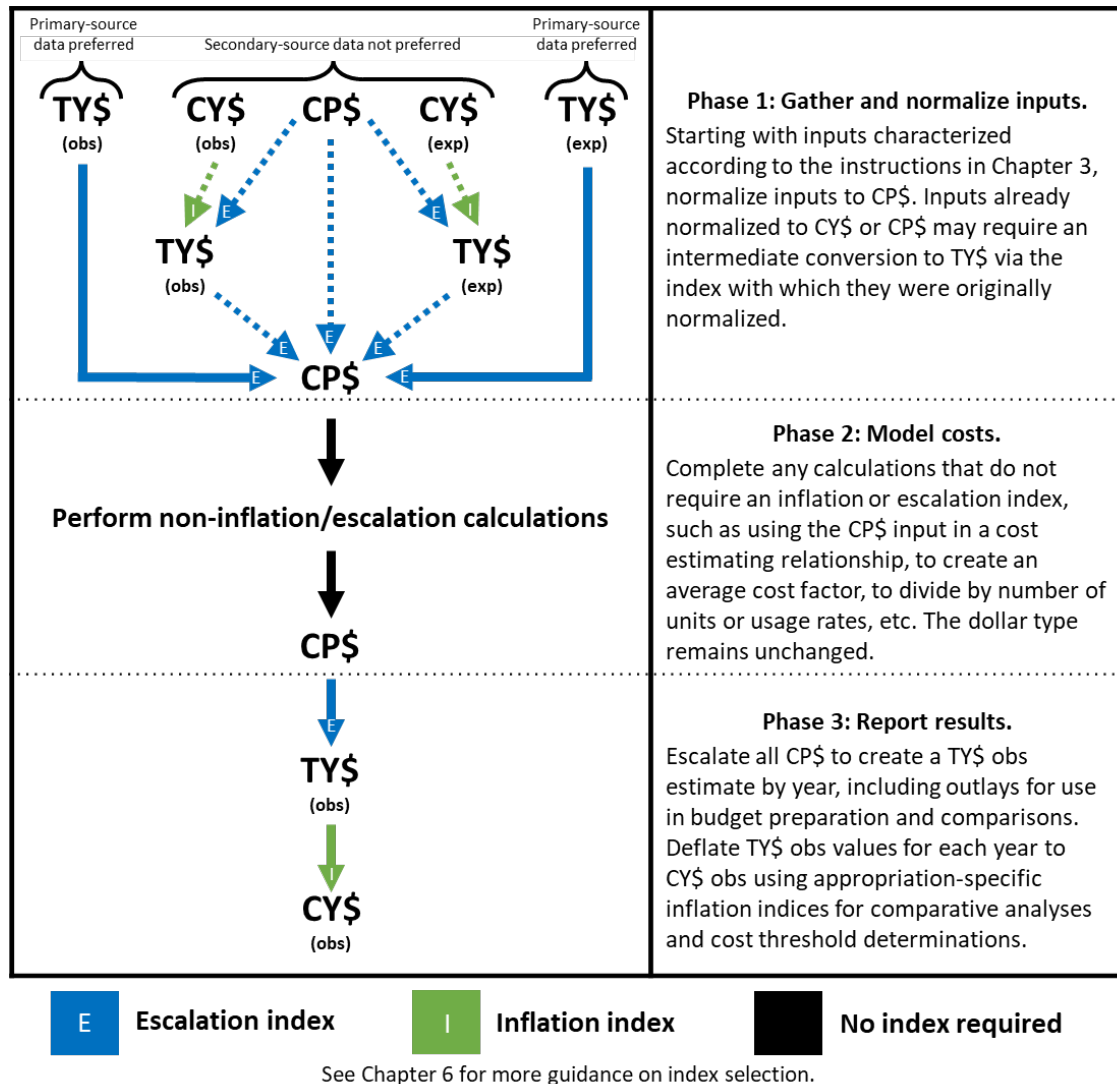
Most of the inputs in your cost estimate will undergo multiple rounds of calculations before reaching a value for presentation, with the output of one calculation becoming the input of the next. This chapter explains the rationale for using various dollar types for each input-output conversion in your estimate, and discusses the potential pitfalls of producing an inappropriate dollar type. As a quick reference, Figure 5-1 below lists the circumstances under which you should or should not use particular dollar types.

Figure 5-1. Applications of various output types.

	Recommended for...	Not recommended for...
CP\$	<i>Intermediate calculations:</i> • Average cost factors • Cost Estimating Relationships (CERs) • Cost Improvement Curves (CICs) • Visualizing programmatic trends	<i>Reporting final values:</i> • External reports beyond DoD cost community, unless well-documented and necessary to explain cost estimate methodology
TY\$ obs and CY\$ obs	<i>Reporting final values:</i> • Total costs • Reports for stakeholders beyond DoD cost community: – Budget (actual budget values in TY\$ obs, with CY\$ obs for comparison in some displays) – Acquisition Program Baseline (APB) – Selected Acquisition Report (SAR) – Analysis of Alternatives (AoA) – Business Case Analysis (BCA) – Affordability Analysis	<i>Intermediate calculations:</i> • Calculations other than addition and subtraction with other values of same type (and same base year if CY\$ obs) • Average cost factors across multiple years • CERs • CICs
TY\$ exp and CY\$ exp	<i>Displaying data obtained from primary sources that capture expenditures</i>	<i>Intermediate calculations or reporting final values (see above)</i>

Additionally, Figure 5-2 provides a generic flow diagram of a cost estimate from initial data collection to the final reporting of results, showing the dollar type you should use at each stage. Section A of this chapter describes the initial normalization of inputs in detail, section B explains why you should perform intermediate calculations in CP\$, and section C explains why you should report final costs only in TY\$ obs and CY\$ obs.

Figure 5-2. Output types at various points in cost estimating process (“Pitchfork Chart”).



A. Normalizing data for use in calculations

Cost analysts obtain data from many different sources, and typically must convert them to comparable units prior to performing calculations or reporting results. In Phase 1 of Figure 5-2, this normalization process shows that you should normalize all inputs to CP\$ prior to using them in cost estimating relationships, cost improvement curves, and

other standard cost estimating methodologies.¹⁵ Normalizing a set of TY\$ costs using a particular escalation index (e.g., five years' worth of historical data for a given cost element) to CP\$ restates the costs in a common unit so that they can be used together in calculations. Note that CP\$ produced via different escalation indices (e.g., aircraft production index vs. engine production index) *cannot* be used together in calculations, as the units of measure (as captured by each index) are not the same.

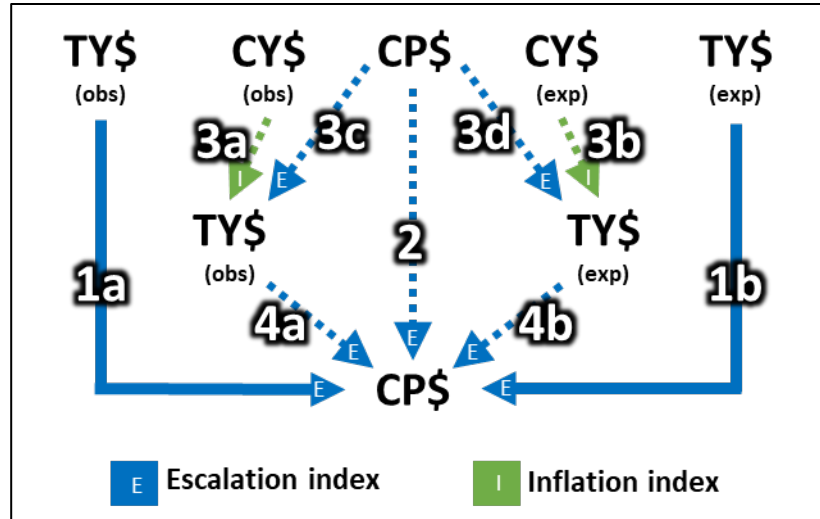
Prior to the introduction of CP\$ as a concept around 2015, cost estimators were generally taught to normalize costs to “base year dollars” or “constant year dollars” prior to using them in calculations. This handbook recommends normalizing all the way to CP\$ because doing so removes the effect of as many time-correlated economic phenomena as possible (i.e., real price change in addition to inflation). Normalizing data to CY\$ leaves behind historical real price change, which may not be representative of future escalation. Removing *all* escalation prior to performing calculations provides more time-independent results, and then you can apply forecasted escalation rates to the results with less risk of double-counting.

The process shown in Figure 5-2 for normalizing each type of input is reproduced in Figure 5-3 below for a more detailed explanation of each labeled arrow. While this section deals only with reaching CP\$ for further calculations, you will find information about index selection for all kinds of conversions in Chapter 6. Although this graphic may appear confusing at first, keep in mind that all paths lead to CP\$ for use in subsequent calculations; the graphic simply accounts for all scenarios you may encounter when collecting inputs, with five possible dollar types and, for pre-normalized data in CP\$, varying degrees of satisfaction with the index that originally produced them.

In the course of following the steps below, you should also consider whether to normalize your input for features like fees, overhead (e.g., G&A, FCCM), and other components. For example, you may be using a historical contract cost that includes a particular fee percentage, but plan to use the input in a CER built with data that did not include similar fees. Since these types of costs are often applied as percentages on top of real-world costs (TY\$), you should remove them prior to normalizing the inputs to CP\$; if you normalized the costs prior to removing a fee percentage, there would be a slight error in the results.

¹⁵ Calculations that do not involve time-correlated data are not discussed in this chapter. For example, you may divide any cost type (TY\$, CY\$, or CP\$) by number of units produced, number of hours flown, number of miles driven, etc., without prior normalization if the costs are already in the desired dollar type. You should document the cost type of the numerator in metrics like these (per the instructions in Chapter 9) so other analysts will know whether the costs were normalized relative to an index.

Figure 5-3. Normalizing inputs (Phase 1 from Figure 5-2).
Calculations along solid lines are preferred over those along dashed lines.



- For **Arrows 1a, 3a, 3c, and 4a**, the notes below will call for the use of weighted indices. In most cases, you will also need the underlying raw index (i.e., without the outlay profile represented in the weighted index). For the sake of readability in the following bullets, the references to weighted indices for which you will also need the underlying raw index will be marked with an asterisk (*). See Chapter 7 section A for details on these calculations.
- **Arrows 1a, 1b:** The use of TY\$ inputs (either obligations or expenditures) is preferred because they represent primary-source data that has not been normalized by information systems or other analysts (see Chapter 4 section B). When converting TY\$ data to CP\$ for further calculations, you may select any escalation index that is appropriate for your data and analytical purposes.
 - **Arrow 1a, TY\$ obs to CP\$:** Use a weighted* escalation index.
 - **Arrow 1b, TY\$ exp to CP\$:** Use a raw escalation index.
- **Arrow 2:** You may follow this arrow if both of these conditions apply: (1) the index used to generate the CP\$ input includes appropriate content for your purposes, and (2) the index is compatible with any further calculations you will complete, such as CERs. For example, say you have a CP\$ input that was normalized using an escalation index for commercial helicopters. If you also would have chosen the commercial helicopters index, and plan to use the CP\$ value as an input to a CER built with CP\$ data normalized with the same helicopter index, you may use the CP\$ input directly (note that you may need to change the base year to match). If, however, you plan to use the helicopter-CP\$ input in a CER developed using a generic aviation index, you should follow arrow 3c or 3d instead. In that case, arrows 3c and 3d would be the helicopter escalation

index (weighted* or raw, respectively), and subsequent use of arrows 4a or 4b would involve the generic aviation escalation index (weighted* or raw, respectively).

- **Arrows 3a-3d:** For CY\$ inputs and CP\$ inputs for which the conditions above (for arrow 2) are not met, you must attempt to “undo” the normalization that produced them. In other words, you must convert them to TY\$ as an intermediate step, getting as close to the original primary source data as possible. To minimize error in this step, you should ideally use the *same exact index* that produced the CY\$ or CP\$ input from the original primary source data.¹⁶ If you do not have a copy of the original index (the most likely scenario), use your best judgment to select as close a substitute as possible.¹⁷
 - **Arrow 3a, CY\$ obs to TY\$ obs:** Use a weighted* inflation index (matching the original index if possible) to convert to TY\$ obs, then follow arrow 4a with your preferred weighted* escalation index to convert to the desired CP\$.
 - **Arrow 3b, CY\$ exp to TY\$ exp:** Use a raw inflation index (matching the original index if possible) to convert to TY\$ exp, then follow arrow 4b with your preferred raw escalation index to convert to the desired CP\$.
 - **Arrow 3c, CP\$ to TY\$ obs:** Use a weighted* escalation index (matching the original index if possible) to convert to TY\$ obs, then follow arrow 4a with your preferred weighted* escalation index to convert to the desired CP\$.
 - **Arrow 3d, CP\$ to TY\$ exp:** Use a raw escalation index (matching the original index if possible) to convert to TY\$ exp, then follow arrow 4b with your preferred raw escalation index to convert to the desired CP\$.

¹⁶ You are most likely to possess this information if you have access to a detailed cost model in which you can trace the formulas that produced the CY\$ or CP\$ value you want to use. If that is the case, you should use the primary source data itself (following arrows 1a or 1b) rather than starting from normalized versions of the same data in CY\$ or CP\$.

¹⁷ The judgment calls that may be required for the four arrows in this group are more difficult for CP\$ inputs than for CY\$ inputs. There is a wider range of potential indices that could have produced a CP\$ input (any escalation index) than could have produced a CY\$ input (inflation indices only). Although there are several ways to calculate inflation, DoD cost estimates all should use the GDPPI (which is the basis of the Comptroller-provided inflation indices) and only differences in the index publication date or appropriation are likely to skew the results. For CP\$ inputs, blindly selecting an escalation index to try to recreate the original TY\$ value could create a TY\$ value that has no real-world relevance. You should generally avoid using pre-normalized inputs for this reason, as described in Chapter 4 section C. See Chapter 8 section B for more information on the possible error a poor assumption could introduce.

- **Arrows 4a-4b:**

- **Arrow 4a:** TY\$ obs to CP\$: Use a weighted* escalation index.
- **Arrow 4b:** TY\$ exp to CP\$: Use a raw escalation index.

B. Output types for use in calculations (CP\$)

Once you have normalized your inputs to CP\$, you can proceed with the non-inflation and non-escalation calculations you normally complete for a cost estimate. For example, you can use multiple years' worth of CP\$ costs to generate an average annual cost factor, use the normalized costs to build or use a CER, or calculate a cost improvement curve.¹⁸ As previously discussed, calculations such as dividing costs by number of units or measures of operating tempo are not discussed in detail; whatever dollar type went into those calculations will be the dollar type of the numerator coming out (e.g., TY\$ obs divided by flying hours yields TY\$ obs per flying hour).

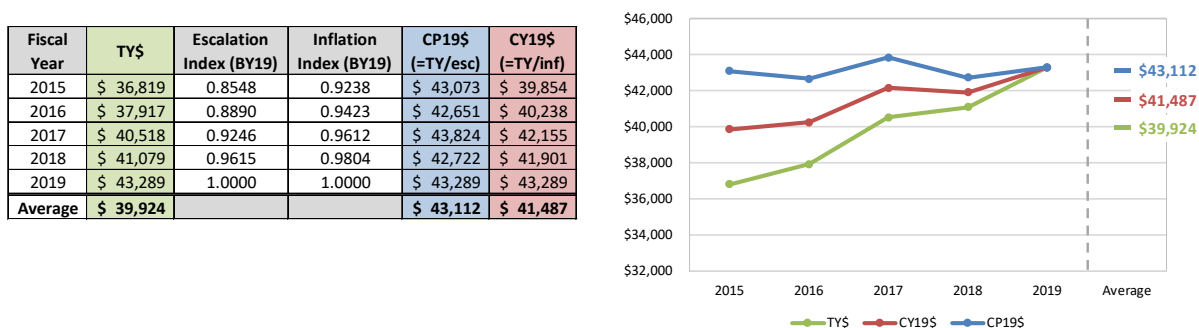
In addition to providing instructions, the following sections demonstrate the fact that index selection for initial data normalization can have a substantial effect on subsequent calculations and the nature of the relationships observed in the data. Future analysts may need access to the exact indices you applied prior to performing more advanced calculations, so you should be sure to include full copies of such indices in your project documentation.

1. Average cost factors

For some cost elements, you may simply take an average of historical costs to create an annual cost factor for extrapolation to future years. For example, say you obtain a five year history of annual training costs from 2015 to 2019, and want to use the average of those historical costs as the basis of a forecast for 2020 (assume training costs use one-year money, which allows us to ignore outlay profiles for this example and use only raw indices). Notional TY\$ exp data and two relevant (notional) indices are provided in Figure 5-4 below, and you normalize the costs to both CP19\$ and CY19\$ exp for comparison.

¹⁸ This chapter does not discuss learning curves on their own because they are performed on labor hours, not costs. A cost improvement curve is functionally similar to a learning curve, but used when the labor hours are not known or when the analyst wishes to analyze efficiency improvements at a more aggregated level.

Figure 5-4. Calculating average cost factors from historical costs.



Out of the three options for averages calculated above, you immediately rule out using the average calculated in TY\$ because it has lost any connection to a particular point in time (i.e., the average is a mixture of transaction years, and there is no unifying base year for TY\$). You decide to convert the CP19\$ and CY19\$ averages to TY\$ in 2020, which is the value you are forecasting, to compare the results. Let’s assume forecasted escalation from 2019 to 2020 is four percent (index = 1.04), and forecasted inflation is two percent (index = 1.02).

- Escalate CP19\$ average to TY\$ in 2020: $\$43,112 \times 1.04 = \$44,836$
- Inflate CY19\$ average to TY\$ in 2020: $\$41,487 \times 1.02 = \$42,317$

Are these results just different or is one better than the other? The CP\$ method provides a more accurate TY\$ forecast because it does not suffer from three problems that exist in the CY\$ method. First, the average calculated in CY19\$ included some real price change that occurred over the historical period: a clear upward trend in costs remained even after inflation was removed, indicating that the average includes some unexplained time-correlated variation. That unexplained variation represents an error term that will persist if you use the CY19\$ average in future calculations. Second, the conversion of the CY19\$ average to TY\$ in 2020 applies only inflation, and omits forecasted real price change. Although there is some real price change already “baked into” the CY19\$ average as previously discussed, this effect is difficult to conceptualize and separate from the anticipated real price change in the future. Third, and more generally, this example used TY\$ exp data and CY\$ exp are not ideal for cost estimating purposes because they are not compatible with budget analyses, which are obligations-oriented. The CP\$ method is preferred, as all escalation was removed prior to calculating the average (so no real price change was baked into the result), and the full amount of forecasted escalation was then applied to reach TY\$.

2. Cost Estimating Relationships (CERs)

A cost estimating relationship (CER) is a parametric model that seeks to determine the statistical relationships between program costs and the characteristics of sampled weapon systems. Cost analysts use CERs to predict the cost of a future program given its planned or known characteristics. Most CERs gather data for programs from different points in time, and each program's cost must be normalized to a common base year in order to eliminate the effect of program timing on the relationship between cost and technical characteristics.

To remove as much time-correlated price change as possible, you should normalize costs to CP\$ for use in CERs. When building a CER, select an escalation index that is appropriate for all data points—you may have to use an index that is slightly broader in scope if a more narrowly defined one is not appropriate for all data to be included. When using a CER, the index you use to normalize your inputs to CP\$ (see section A above) should be the same index as was used to generate the CER.¹⁹ The following example will show how the cost normalization choice affects the estimated relationships for a given set of data.

Suppose you are estimating the Detail Design phase for a new ship, slated to start in 2018, based on actual costs for analogous programs. For simplicity, assume weight (measured by full-load displacement in thousands of long tons) is the sole cost driver. During Detail Design, the DoD primarily buys labor to solve system design problems, and often the assumption is that a relationship exists between the cost driver (weight) and the amount of resources (i.e., the number of labor hours). In this example, ship design resource costs have escalated at 3.5 percent as opposed to 2.0 percent for the economy-wide measure of inflation. Normalizing historical TY\$ with escalation will remove distortions to the purchasing power of the dollar with respect to ship resource costs, revealing the “true” underlying relationship between weight and resources (labor hours). Figure 5-5 below shows the available information for six analogous programs, with some costs normalized to CY\$ or CP\$ with a base year of 2016.

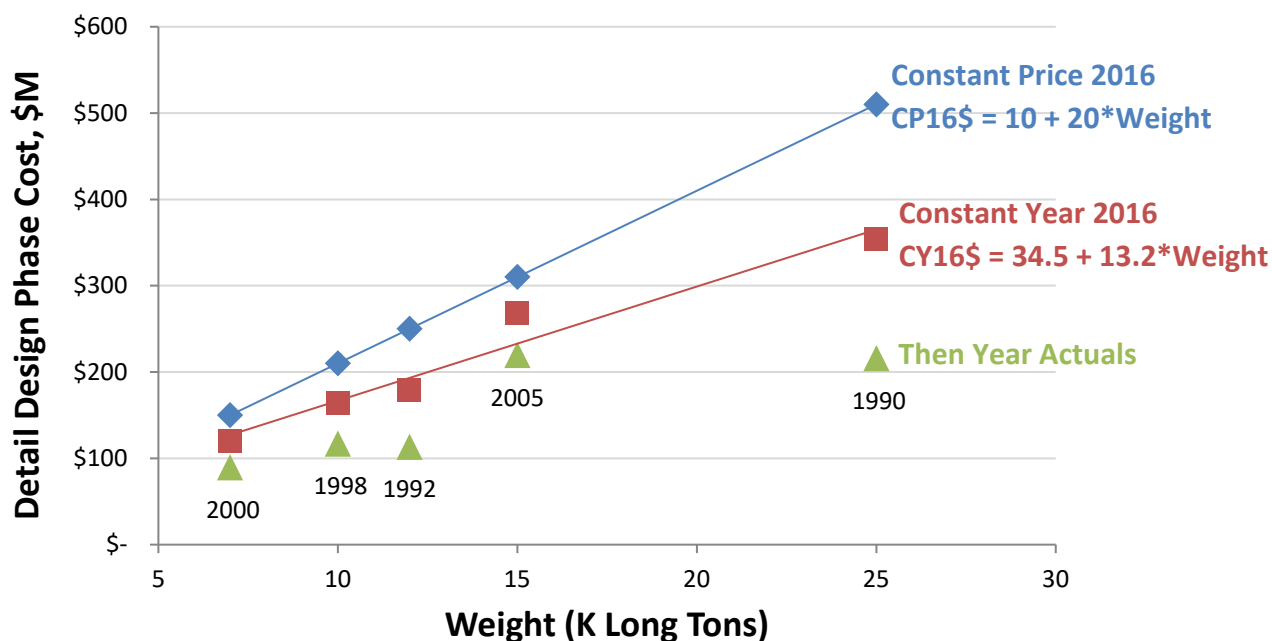
¹⁹ You should use an updated version of the same index, if available. Most indices are published annually or quarterly, and later releases will gradually replace forecasted values with actuals as they become known. If you use an outdated index with forecasted values that did not match what actually occurred, you will introduce error into your results.

Figure 5-5. Analogous program information for CER example.

Assumptions: Inflation = 2.0%, Escalation = 3.5%						
Year	(A) Ship Weight (K LT)	(B) TY\$M obs	(C) Escalation Index, Wtd.	(D) CP16\$M (=B/C)	(F) Inflation Index, Wtd.	(G) CY16\$M obs (=B/F)
1990	25	\$215.2	0.422	\$510.0	0.609	\$353.6
1992	12	\$113.0	0.452	\$250.0	0.633	\$178.4
1998	10	\$116.7	0.556	\$210.0	0.713	\$163.6
2000	7	\$89.3	0.595	\$150.0	0.742	\$120.3
2005	15	\$219.1	0.707	\$310.0	0.819	\$267.5

Because escalation in ship design resource costs have outpaced inflation, the historical programs' costs viewed in CP16\$ are higher than in CY16\$. A scatterplot with cost as a function of weight is shown in Figure 5-6 below, and highlights the different views of the relationship. Note that the CER performed in CY\$ returns a shallower slope (an additional 1,000 tons of weight costs CY16 \$13.2M compared to CP16 \$20M).

Figure 5-6. Cost Estimating Relationships in CY\$ vs. CP\$.



The example data assumes that ship weight has a perfect linear relationship with the analogous Detail Design phase costs when measured in CP\$. The relationship exists between weight and escalation-adjusted CP\$, and not inflation-adjusted CY\$, because it is assumed that ship development of a given weight requires a certain amount of

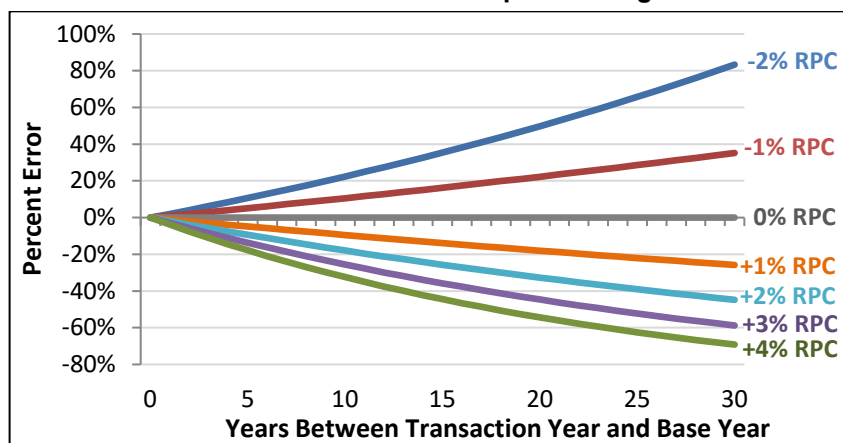
resources, not dollars.²⁰ The result should be a CER with improved statistics. The relationship takes the form:

$$CP16\$ = f(Weight) = \$10M + \$20M * Weight (K LT) + \varepsilon$$

The equation states that ship Detail Design would cost on average \$10M in CP16\$ plus \$20M for each additional 1,000 tons. (The epsilon reflects a standard error term reflecting all other factors not accounted for by weight.) If the new ship program is planned to weigh 30,000 long tons, the CP\$ CER would predict a cost of $(\$10M + \$20M \times 30K LT) = CP16 \$610M$. The CY\$ CER, however, would predict a cost of $(\$34.5M + \$13.2M \times 30K LT) = CY16 \$431M$. Converting both of these to TY\$ obs for 2018 (the start of Detail Design) returns final TY\$ Detail Design costs of \$674M for the CP\$ method and \$456M for the CY\$ method—a difference of 32 percent.

Although the previous example compared CERs built in CP\$ versus CY\$, similar deltas in the output could arise from choosing different escalation indices (i.e., CP\$ produced via indices with different escalation rates). It is important to select an escalation index that is appropriate for the programs whose data you are using, otherwise you could distort the relationship between costs and technical parameters. Errors in characterizing the inputs for a CER (such as transaction year) or selecting an appropriate escalation index will result in a CP\$ that is too high or too low, depending on the length of time over which the cost is normalized (i.e., the time between transaction year and base year) and the rate of escalation (see Figure 5-7).

Figure 5-7. Error in normalizing to CP\$ (relative to CY\$) depends on time period of normalization and rate of real price change.



²⁰ It would also be valid to apply an escalation index measuring the quality-constant costs of “representative” Detail Design outputs (e.g., ship engineering documents and models). This application assumes the underlying relationship exists between ship weight and dollars, but such escalation indices for unique defense outputs often do not exist. Analogous commercial indices may also be lacking. See Chapter 6 for additional insight on selecting the proper escalation index.

This percent error in costs will cause a distortion in the alignment of data points and therefore the coefficients of the CER equation. To avoid this possible error when building a CER, you must first accurately characterize each data point per the instructions in Chapter 4. Second, follow the guidance in Chapters 3 and 6 to ensure that you select an index that is relevant to each data point (e.g., if you are creating an engine CER and have two different types of engines, you should use a generic “engines” escalation index rather than a more specific index that only applies to some of the data points, or a mixture of more specific indices).²¹ More information on the effect of index selection and other advanced CER development topics is available in Appendix E, including considerations for CERs that use technical characteristics that are themselves correlated with time (e.g., weight has been steadily increasing or decreasing from one program to the next chronologically).

3. Cost Improvement Curves (CICs)

When line workers perform repetitive tasks in the production of large complex end items in an environment of continuous pressure to reduce costs, they learn to become more efficient and their processes improve, resulting in fewer direct labor hours being needed to produce each subsequent item. Experience shows that for every doubling of cumulative production quantity, touch-labor hours tend to decrease by a fixed percent, as long as the increase in production quantity is within the capacity limits of the facility, process, and/or workforce. This learned efficiency can be measured in labor hours to produce a “learning curve (LC),” or in dollars to produce a “cost improvement curve (CIC).” When analyzing labor costs instead of hours, the data must be normalized to remove the effect of escalation and expose learning that occurs on the underlying labor hours.

Normalization for dollar types does not affect LCs because they are measured in hours rather than dollars, whereas the normalization required to generate a cost improvement curve (i.e., the amount of escalation removed) does affect projected cost savings from learning. You should refer to Chapter 3 for guidance on removing pricing effects for these calculations, as it can be difficult to tease apart the pricing effects that you want to remove from any quantity- and quality-driven variation you may want to preserve.

²¹ If you are unable to find an escalation index that is appropriate for all data points, you should consider whether the data share enough common characteristics to make them appropriate to combine in a CER.

With information on hours, you could regress the hours-per-unit on the quantities and estimate a learning slope and a first-unit (T_1) cost that define the LC (see the link below²² for more information on these terms and calculations). Lacking data on hours, you can use the *dollars*-per-unit to back into the underlying learning which occurs on labor *hours* (thus producing a CIC). Because the purchasing power of the dollar has changed over time, you cannot estimate the learning on TY\$ without unintentionally building changes in time-correlated labor prices into the equation.

In the following example, you will determine the cost of seven new annual production lot buys that span years 2017-2023. Assume that labor costs are known to be \$10 per hour in 2016, which has experienced, and is expected to continue experiencing, 2.00% real price change over a 2.00% inflation rate (or an escalation rate of 4.04%).

A learning curve for this data would produce a learning slope of 87.4% and a T_1 cost of 157 hours. This learning curve estimates labor hours as a function of cumulative quantity, the proper object of learning. Projected labor rates can then be applied to estimated hours to derive a total cost. Figure 5-8 shows this learning curve calculation (for normal program data) along with several examples of CICs to illustrate a variety of approaches: Table 1 shows the learning slope and T_1 hours, which is generally preferred when available, and Table 2 shows three possible CICs, generated for CY\$ and two potential CP\$ options.²³

²²<https://www.dau.edu/cop/ce/DAU%20Sponsored%20Documents/Learning%20Curve%20Workshop%20Unit%20and%20Cum%20Avg.pdf>

²³ Note that the CY\$ presented in this example represent CY\$ exp because they were produced from TY\$ exp inputs. As shown in Figure 5-1, you should not use CY\$ exp to build CICs—this example simply shows CY\$ exp for comparison, and demonstrates the fact that building a CIC with CY\$ exp produces a result that fails to match the result from a corresponding learning curve.

Figure 5-8. Learning Curves vs. Cost Improvement Curves and the impact of index selection.

Table 1. Learning Curve: Hours per unit are known or can be calculated.

Year	Cumulative Quantity (Midpoint)	Avg. Unit Cost (TY\$)	Hourly Labor Rate (TY\$)	Avg. Hours per Unit
2010	7.5	\$838.3	\$7.885	106.3
2011	29.7	\$667.4	\$8.203	81.4
2012	50.0	\$627.7	\$8.535	73.5
2013	70.2	\$611.6	\$8.880	68.9
2014	90.3	\$606.0	\$9.238	65.6
2015	110.3	\$606.4	\$9.612	63.1
2016	130.3	\$610.9	\$10.000	61.1

Learning Rate:	87.4%
Theoretical First Unit Hours:	157.2

Escalation Index 1 below was derived from the recorded Hourly Labor Rates so that it would perfectly describe price escalation for this program's labor rates. When the escalation rate used for normalization removes exactly the full rates of inflation and real price change, the only remaining cost drivers become quantity and quality changes (see Chapter 3 for the Cost Estimator's Framework). Assuming that this estimate is for a constant-quality product, the resulting Cost Improvement Curve has the same coefficients as the Learning Curve, and produces the same TY\$ estimate.

Table 2. Cost Improvement Curve: Hours per unit are not known, multiple indices available to normalize costs.

Year	Cumulative Quantity (Midpoint)	Avg. Unit Cost (TY\$)	Inflation Index	Avg. Unit Cost (CY16\$ = TY\$/Inflation Index)	Escalation Index 1	Avg. Unit Cost (CP16\$ = TY\$/Escalation Index 1)	Escalation Index 2	Avg. Unit Cost (CP16\$ = TY\$/Escalation Index 2)
2010	7.50	\$838.3	0.8880	\$944.0	0.7885	\$1,063.2	0.7050	\$1,189.1
2011	29.70	\$667.4	0.9057	\$736.9	0.8203	\$813.6	0.7473	\$893.1
2012	50.00	\$627.7	0.9238	\$679.5	0.8535	\$735.4	0.7921	\$792.5
2013	70.20	\$611.6	0.9423	\$649.1	0.8880	\$688.7	0.8396	\$728.4
2014	90.30	\$606.0	0.9612	\$630.5	0.9238	\$656.0	0.8900	\$680.9
2015	110.30	\$606.4	0.9804	\$618.5	0.9612	\$630.9	0.9434	\$642.8
2016	130.30	\$610.9	1.0000	\$610.9	1.0000	\$610.9	1.0000	\$610.9

Cost Improvement Rate:	89.9%
Theoretical First Unit Cost:	\$1,295

87.4%
\$1,572

85.2%
\$1,886

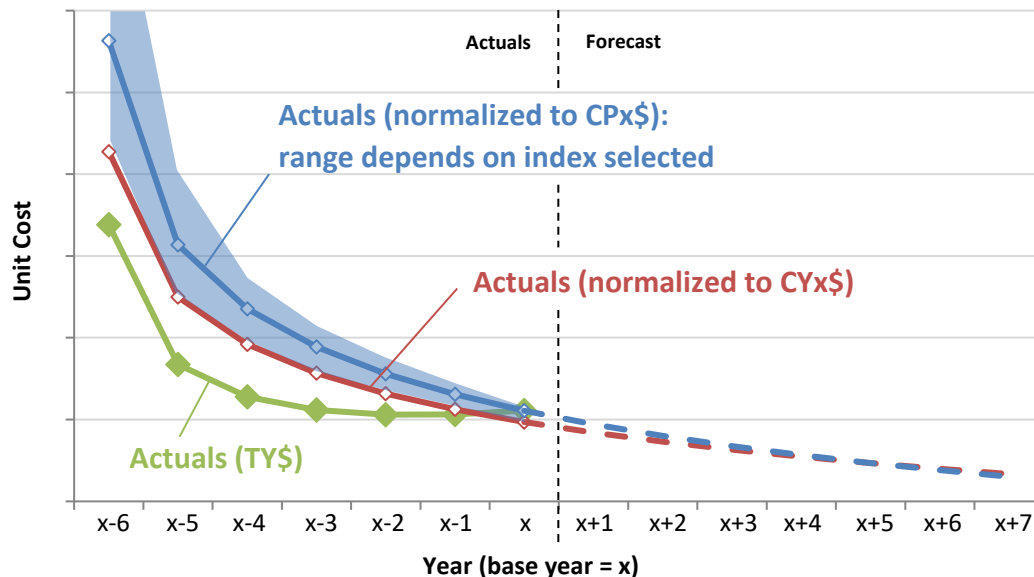
In most cases, if you are using a Cost Improvement Curve, you either do not have enough information to complete a Learning Curve or you do not want to use labor hours alone to model future costs. In these cases, you will not likely know the "perfect" escalation index to produce a CP\$, and may have multiple options for how to normalize the TY\$ costs to CP\$ for regression.

There are two primary takeaways from the example in Figure 5-8. First, a CIC using CP\$ that were normalized with a "perfect" escalation index, or one that completely describes the rate of escalation in the costs, produces the same slope and T_1 value (157.2 hours versus \$1,572 at \$10 per hour) as a learning curve (see Appendix E for graphs). Second, CICs produced in CP\$ yield different slopes and T_1 values depending on the amount of escalation removed when normalizing the TY\$ raw data; normalization for larger positive rates or smaller negative rates produces CICs with steeper slopes and higher T_1 values compared to normalization for smaller positive rates or larger negative ones. This fact highlights the importance of selecting appropriate escalation indices as described in Chapters 3 and 6, as you will often have to choose among multiple escalation indices in real-world applications.

The graph in Figure 5-9 is a generalized visualization of the concepts described above, showing the various options for normalizing TY\$ data to build a CIC. In this picture, the year "x" is the last year of actuals available, and all historical data points are normalized to that base year. There is only one option for normalizing the TY\$ data to CY\$ (red) because there is only one rate of inflation, but multiple options for normalizing

the data to CP\$ (blue).²⁴ The CP\$ line in the middle of the blue range represents the “perfect” CP\$ CIC that perfectly matches a learning curve that captures the labor hours directly.

Figure 5-9. Cost improvement curves in CY\$ vs. CP\$



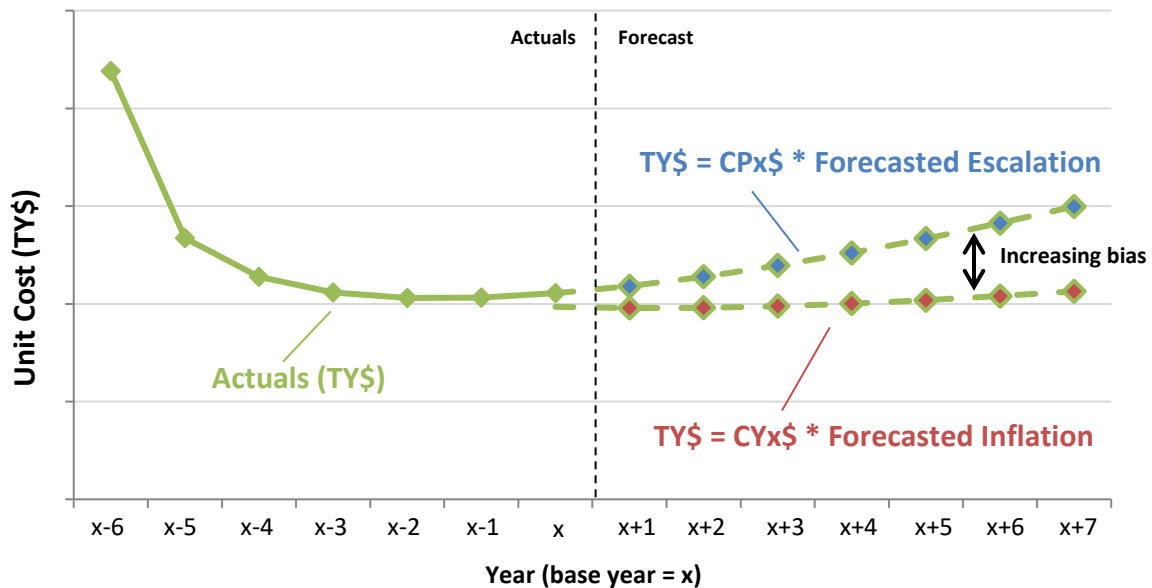
As you can see, the shape of the CIC (and therefore its coefficients for the slope and first-unit costs) depend on the index selected for normalization. There is only one line for CY\$ because there is one rate of inflation for all commodities, but the shaded area around the CP\$ line reflects the variability of curves that could result from using different escalation indices to produce CP\$. You should use your best judgment in selecting an escalation index that reflects the economic circumstances of the cost element in question, and may wish to try fitting the curve with a couple of different relevant indices to determine how sensitive your results are to index selection.

Although the lines appear to converge in Figure 5-9 regardless of the index used for normalization, one is in CY\$ and the other is in CP\$, and they must both be converted to TY\$ for direct comparison and to report the total TY\$ estimate values. To convert to TY\$, you would apply forecasted inflation to each point on the CY\$ curve, and you would apply forecasted escalation to each point on the CP\$ curve. Assuming escalation is greater than inflation (i.e., real price change is positive), you would see a diverging trend like the one in Figure 5-10 below. The forecasted TY\$ costs would be higher using the CP\$ CIC than using the CY\$ CIC because the CY\$ version neglects future real price

²⁴ The blue area shown may in fact be wider, even cutting into the area between the CY\$ and TY\$ lines or below the TY\$ line if real price change is negative. The area shown here assumes that real price change is positive, though that is not always the case. See Appendix C for more information.

change. The difference between the two models (or between two CP\$ models developed using different escalation indices) depends on the time period and difference in forecasted price change rates.

Figure 5-10. CICs developed using CY\$ underestimate future costs when real price change is positive.



The use of CP\$ in cost improvement curves seeks to strip away noise in the change of the dollar’s purchasing power relative to the proper object of learning curve analysis, labor hours. Because information regarding past and future escalation rates is often noisy itself, it is recommended that cost estimators seek to use effort (labor hours) data whenever possible for estimating learning curves. If you obtained a perfect, quality-adjusted escalation index to normalize the data for a CP\$ cost improvement curve (which is likely hard to find), it would provide the same results as a learning curve built on labor hours. A cost improvement curve in CP\$ is a second-best method when only costs (dollars) are available and labor costs can be targeted. See Appendix E for an extended example.

4. “Why can’t I do these calculations in CY\$ or TY\$?”

The above sections showed that cost estimating formulas will produce different results when developed with inputs in different dollar types, so you may be wondering why developing them in CP\$ is not just different, but preferred. After all, you can build equations using any kind of numbers, and you may think that you could get a valid result as long as you use compatible numbers throughout (e.g., use TY\$ as an input to an equation designed for TY\$). However, formulas built using TY\$ or CY\$ inherently build in some amount of escalation or real price change, respectively, that occurred between historical data points, which is unlikely to be perfectly replicated in the future.

For example, the CY\$ CER in Figure 5-5 included data points from 1990 to 2005, and those points experienced some amount of real price change relative to each other during that time. If you wanted to use that CER to predict the CY\$ cost of a unit purchased in 2025 based on weight, you would have to assume that wherever the future program's weight fell on the y-axis, the x-coordinate on the CER line would automatically include the exact amount of real price change that occurred between the base year of the CER and the program's transaction year. This result is not probable, as no point on the CER included real price change that may have occurred after 2005, and each point represents a varying amount of real price change relative to the base year of the equation. If the CER had been built in CP\$ instead, it would have removed this correlation of cost with time.

Normalizing input data prior to performing calculations is not a new concept, but the idea of using CP\$ rather than CY\$ may be new to many readers of this handbook. If you are still uncomfortable with the distinction, consider the fundamental reason for normalizing data in this context: to enable direct comparisons without distortions due to timing. If it made sense to remove inflation for this purpose when you first learned cost estimating (likely prior to the publication of this handbook), it should make even more sense to remove escalation. Removing inflation would only achieve part of the goal of removing timing-induced distortions in costs.

5. “Can I still use an old CER that was built in CY\$?”

The previous sections argue for using CP\$ in CERs, but you may still wish to use CY\$ equations that your organization endorsed prior to the publication of this handbook. You should consider rebuilding the analysis in CP\$ if it is practical to do so; however, continued use of CY\$ equations is permissible in cases where zero real price change for all data points during the historical period is a defensible assumption. If you determine that the assumption of zero real price change is defensible, you should include your reasoning in your estimate documentation. You should also treat the output of any such CER as a CP\$ value, and apply the full rate of forecasted escalation to reach TY\$ in subsequent steps (in accordance with the diagram in Figure 5-2).

C. Output types for external reports, including budgets and other decision making (TY\$ obs and CY\$ obs)

Although you should perform most cost estimating calculations in CP\$ as described in the previous section, you should generally not present CP\$ results to decision makers—they may lack the context to fully understand what CP\$ represent for any given cost element (see Chapter 8 section C for more information). Constant prices have no real-world significance because prices generally do not remain constant over extended periods, and the indices that produce them may reflect highly specialized economic

sectors with which decision makers are not familiar. For example, a cost estimate for aircraft production that uses an aircraft-specific index to report CP\$ would be stating the costs relative to the aircraft industry, and a decision maker would have to be familiar with the pricing trends of the aircraft industry (which could be measured in many different ways depending on the index selected) to make sense of the CP\$ costs. Rather, cost estimate outputs for presentation to decision makers should be in TY\$ obs and CY\$ obs.

The case for reporting cost estimate results in TY\$ obs is fairly obvious: TY\$ costs represent the actual amount of money that must be available at the time of future transactions, and Federal budgeting deals with obligations that are outlaid over extended periods. Reporting costs in CY\$ obs provides an added point of comparison for those costs relative to the economy, which is useful for several reasons. First, it is a common point of comparison for all programs, and there is no ambiguity in the type of index applied to generate the numbers (inflation only). Second, decision makers from any organization including DoD, Congress, and others can generally relate to broad economic trends, and do not require detailed knowledge of the price trends in particular industries to contextualize the results.

Third, overall economic trends typically drive the total size of the Federal budget and the DoD budget by extension, so normalizing program costs and the budget to CY\$ obs for tradeoff and trend analyses provides a view of the program relative to a constant budget level. Fourth, and perhaps most importantly, costs presented in CY\$ obs preserve the appearance of commodity-specific real price change, which can have significant implications for the long-term affordability of programs. Presenting costs in CP\$ would remove that real price change, and any decisions regarding the program might be at risk if costs grow faster than inflation.

D. Use of TY\$ exp and CY\$ exp as outputs

TY\$ exp and, by extension, CY\$ exp are not typically appropriate output types for presenting cost estimate results because they are not compatible with obligations-oriented DoD budgets, or analyses thereof. TY\$ exp and CY\$ exp are also not appropriate inputs to calculations such as average cost factors, CERs, and CICs for the reasons discussed in section B of this chapter. However, TY\$ exp are a common input type for cost estimates (e.g., CSDR data), so you may wish to include TY\$ exp or CY\$ exp in briefings or other supporting documentation when in-depth discussions of an estimate's source data are required. Any materials presenting TY\$ exp or CY\$ exp should be clearly labeled as such, per the documentation instructions in Chapter 9.

6. Choosing an Index

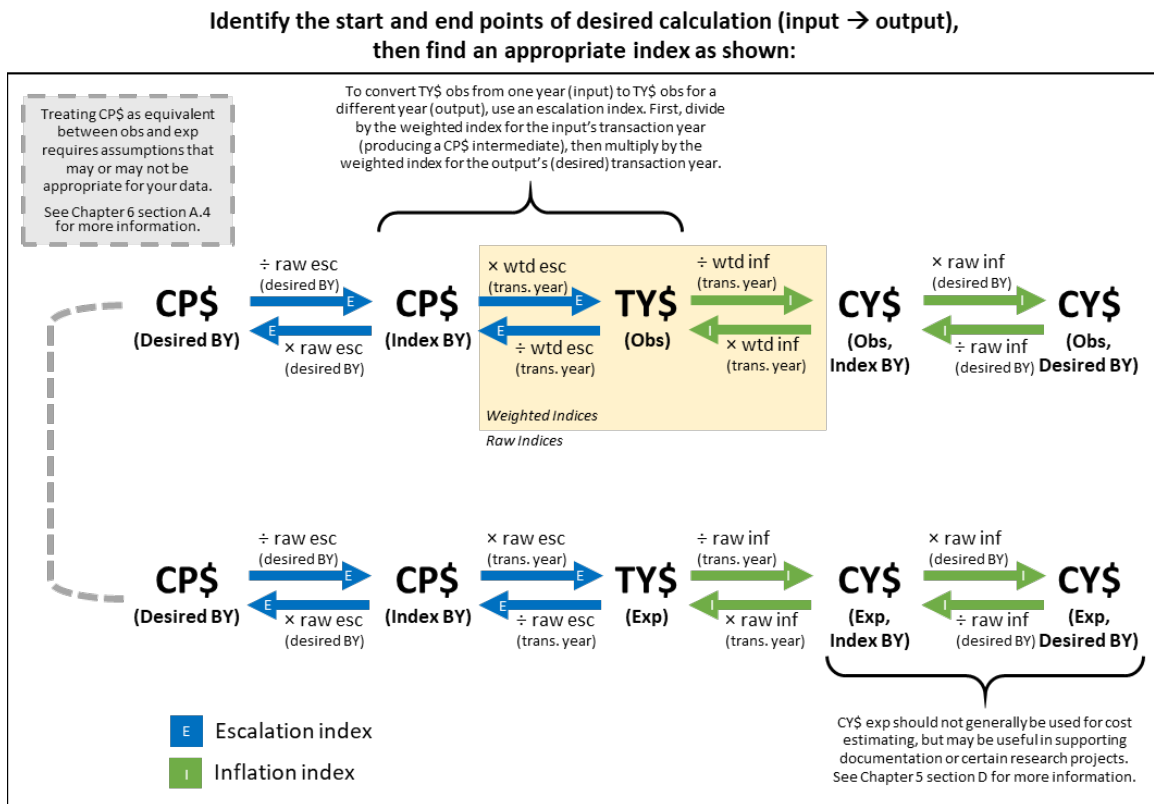
Based on your characterization of each input and output as described in the previous two chapters, you must choose appropriate inflation or escalation indices to convert the inputs to outputs. This chapter will describe the analytical decisions required to select an index: some are automatic based on the conversion you are executing, whereas others will depend on the commodity you are estimating, information available, and time permitted for analysis. The questions you must answer are:

- A. What kind of price change is the conversion meant to capture?
- B. What indices are available for the commodities involved, and which is most appropriate?
- C. Does either the input or output have outlays?
- D. Does the index include all years required?

The following sections will address each of these questions. Also see Figure 6-1 below for a quick-reference guide.

To use Figure 6-1, locate the input type and desired output type as determined using the instructions in the previous two chapters. The arrows joining two points identify the type of index required; for example, if your input is TY\$ obs and you need an output in CY\$ obs, Figure 6-1 shows that you need to divide the TY\$ obs input by a weighted inflation index (and the result will be CY\$ obs in the base year of the inflation index). The text in this chapter will help you understand the indices you find to make sure they are the correct kind for your desired conversions, and Chapter 7 will help you perform the calculations. Choosing an index of a different type than that annotated in Figure 6-1 will produce incorrect results, as discussed in Chapter 8 section A. Consult your agency's best practices when selecting indices to promote consistency and facilitate estimate reviews, but verify that any agency-recommended indices are in fact appropriate for your particular estimate.

Figure 6-1. Flowchart for selecting an index (“Nunchuck Chart”).



A. What kind of price change is the conversion meant to capture?

Based on the determination of input type and output type, Figure 6-1 shows whether you should use an inflation index, escalation index, or both for the desired conversion. The following sections describe these scenarios in detail.

1. Inflation

Most DoD-published indices measure inflation only—they are equivalent to the GDPPI, and capture no commodity-specific price change.²⁵ This fact is somewhat obscured by the commodity-specific names applied to DoD-published indices, such as Research, Development, Test, and Evaluation (RDT&E) and Aircraft Procurement, but in fact they do not reflect DoD pricing experience or industry analysis for those commodities. Instead, these names stem from the application of appropriation-specific

²⁵ Notable exceptions include indices for military pay, civilian pay, fuel, and medical expenses.

outlay profiles in the weighted versions of the indices (more on this in section C), and it is important to note that most account for only inflation.²⁶

2. Escalation

The DoD publishes several escalation indices that describe the net effect of all price change forces on the commodities described. The following indices apply to all Services, but also see Appendix B for a list of Service-specific escalation indices.

- Military pay
- Civilian pay
- Fuel
- Medical expenses

Although most DoD-published indices capture only inflation, you may still use them to describe escalation if you can defend the assumption that the commodity being estimated experiences no real price change (i.e., escalation equals inflation). Doing so may be appropriate for estimating costs for generic goods or services that can be reasonably assumed to fluctuate at a rate comparable to that of the entire economy, but likely inappropriate for unique defense items that represent a small, specialized portion of the economy. For most commodities represented in your estimate, you should explore options other than the GDPPI or DoD-provided indices to capture the full rate of escalation. See Appendix B for more information, including a list of options such as:

- Professional market studies
- Government-published price indices
- Contractors' forward pricing rate agreements
- Contractual economic adjustments
- Historical cost trends
- Historical labor rates

3. Within-type conversions (CY-CY, CP-CP, TY-TY)

Changing the base year of a CY\$ (e.g., CY08\$ to CY17\$) or a CP\$ is more of an administrative task than an analytical one. Such conversions are primarily used to facilitate comparisons across analyses. For example, you may wish to compare unit costs for multiple weapon systems whose Acquisition Program Baselines (APBs) were codified in different base years. Although all of the costs in this APB scenario would have been normalized to CY\$ (see Figure 5-1), they were measured in inconsistent dollar values (i.e., normalized to different points in time). The same would be true for CP-CP

²⁶ Analysts can confirm whether an index is inflation-only by comparing the raw version to the GDPPI. If the indices are equal for all years, the index of interest captures only inflation. If the comparison reveals differences, it must be capturing other forms of price change.

conversions, such as to compare FPRAs released by a contractor at different times. When changing the base year of an input that is CY\$ or CP\$, you must use the same exact index as was used to produce the input when possible. See Chapter 8 section B for a discussion of the bias that can be introduced when using a mismatched index in this case.

Unlike CY-CY and CP-CP conversions that are more administrative in nature, TY-TY conversions can be an essential analytical tool for forecasting costs. The most common use of this process would be when using a single value, such as a subject matter expert's input or single-year contract value, which you expect to recur in a later year (e.g., one-time recurrence, annually, bi-annually, etc.) at a future value that has changed at the rate of a particular escalation index.

4. Assumptions required for “conversions” between obligations and expenditures

Obligations and expenditures are inherently different measures of financial activity: obligations include predictions about future spending patterns (via outlay profiles), whereas expenditures capture actual disbursements. Any attempt to “convert” one to the other requires assumptions about the accuracy of an obligation's outlay profile. Consider the following examples.

A program office obligates \$100M in FY21 for an effort to be performed from FY21-23. They based their \$100M estimate on the total workload, anticipated price escalation over the period of performance, and the assumption that the spending pattern for the effort would reflect the historical average for similar efforts: 40% the first year, 45% the second year, and 15% the third year. The program office therefore expects the effort's annual expenditures to be \$40M in FY21, \$45M in FY22, and \$15M in FY23. This process of “converting” obligations to expenditures is valid, but is based on the assumption that the predicted workload, escalation rate, and outlay profile built into the original \$100M obligation are all accurate. However, those inputs are likely to change: workload could move from one year to another (when prices could be different), or actual escalation rates may vary. The program office could obligate additional funds or de-obligate excess funds over the course of the effort in response. A comparison of the original \$100M obligation to the actual expenditures when the effort is complete is likely to show a delta at the annual or total level (e.g., \$100M originally obligated, \$102M expended if costs exceeded the original estimate by \$2M) that cannot be accounted for via indices as discussed in this chapter.

Conversely, say you are using TY\$ exp data from an analogous program's CSDRs as inputs to a new cost estimate. You graph the actual cost of work performed over time and can calculate the percent of funds expended in each year of the period of performance. When you compare this rate of expenditure to the standard outlay profile for the appropriation that funded the contract, you discover that they are not the same—the outlay pattern for this contract did not reflect historical averages for similar efforts.

You may decide to assume that all funds that were eventually expended for the contract were obligated at the time of contract award, and based on the standard outlay profile published at the time—this procedure effectively “converts” the TY\$ exp from the CSDR data into a TY\$ obs amount in the year of contract award. However, this “conversion” builds in the difference between predicted outlay profile and actual expenditure pattern, and any further calculations will be slightly distorted as described in Chapter 8 section B (first two examples).

The examples in this section show that there is a predicted-versus-actual element to the difference between TY\$ obs and TY\$ exp. Unlike other conversions discussed in this chapter, a “conversion” between TY\$ obs and TY\$ exp requires you to make assumptions about how accurately an obligation predicted the eventual expenditure. A “conversion” from TY\$ obs to TY\$ exp is like saying, “if I have accurately estimated future escalation and the outlay profile perfectly predicts spending patterns, my obligated amount will equal the expended amount, and I will not need to change scope to stay within budget.” Conversely, a “conversion” from TY\$ exp to TY\$ obs is like saying, “if I had known the actual escalation rate and spending profile at the time of obligation, this is the amount I would have obligated.”

Anytime you use inputs that are based on expenditure data (including CP\$ values normalized from TY\$ exp inputs) in a cost estimate—the results of which you will present in TY\$ obs and CY\$ obs—you will have to cross Figure 6-1 (the “nunchuck chart”) from the bottom row (expenditures nunchuck) to the top row (obligations nunchuck). This is possible treating their escalation-normalized values (in CP\$, with not outlays) as equivalent.

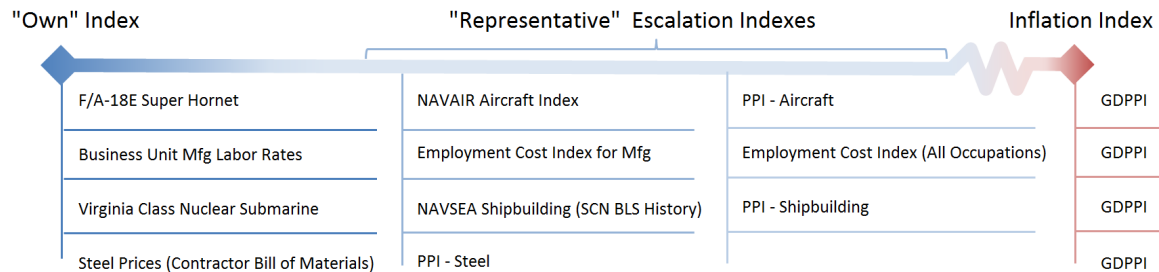
B. What indices are available for the commodity involved, and which is most appropriate?

Though inflation will affect all cost elements regardless of the level of detail, you may assess real price change and overall escalation at whatever level of the WBS makes sense given time constraints and the ability to find indices at different levels. For example, you may choose an index that represents a complete weapon system and apply it at the total level, you may choose multiple indices that represent components within the weapon system, or you may choose indices for specific raw materials and labor categories represented in the estimate.

Figure 6-2 below depicts the spectrum of detail available in indices, which range in specificity from an “own” index developed from program-specific inputs for use within its own estimate, to “representative” escalation indices that are commodity- or industry-specific, to the most general “inflation” index available for the entire economy (GDPPI or GDP Deflator). You are responsible for isolating cost categories with different price

change rates within your estimate, and matching them up with appropriate indices (or making your own if desired).

Figure 6-2. Spectrum of price indices.



In selecting an index, note that relying on an index name is insufficient to determine the true relevance of the underlying data to your estimate. The name of an index may not reveal what types of price change are included (e.g., inflation only, labor only, etc.), and may include multiple cost types (e.g., labor and materials) with different content or proportions than present in your data.²⁷ Understanding the underlying features of an index—beyond the name—is important to determine whether you need to include additional sources of price change, or deconflict between indices that would double-count certain price change effects. For example, contract labor rates may be a factor in both market-specific pricing and FPRAs, so you wouldn’t want to apply both types of indices to a single cost element.

C. Does either the input or output have outlays?

After selecting an index on the basis of the type of price change included (i.e., inflation or escalation) and content (e.g., weapon system level, subsystem level, labor or materials), you must also determine whether the index should include outlays. Indices that include outlay profiles are “weighted indices,” while those that do not are “raw indices.”²⁸ Chapter 7 section E includes instructions for creating weighted indices.

²⁷ There are several “composite” indices published in DoD sources that combine indices for military pay, civilian pay, fuel, and purchases into a single index. The use of these composites can yield results inconsistent with the terminology presented in this guide, because the index is a hybrid of inflation-only (purchases) and escalation (pay and fuel) indices, and thus can produce an output that is a hybrid of CY\$ and CP\$. These indices should be used only with extreme caution to ensure results are properly interpreted and labeled, and should not be used to generate official program baselines meant to be in pure CY\$. If you must use one of these hybrid indices, you should treat it as an escalation index (this method assumes no real price change on the portion of the index that is based on inflation indices).

²⁸ Composite indices may be comprised of both raw and weighted indices depending on how they were created. Composite indices that include any effect of outlays, even on only a portion of the index,

Outlays account for the fact that some types of costs are not fully expended in the year in which they are labeled in a cost estimate. For example, an organization is provided a certain amount of funding in its Operations and Maintenance (O&M) account each fiscal year. These O&M funds must either be obligated by the end of the fiscal year or returned to the Treasury. While the funds must be obligated in that fiscal year, the funds do not have to be outlaid (i.e., leave the Treasury) within the fiscal year. The outlay can, and many times does, occur after the close of the fiscal year.

DoD analysts produce and use indices that are weighted using outlay profiles to reflect commodity-specific patterns in expenditure timing.²⁹ The Under Secretary of Defense (Comptroller) publishes outlay rates for all DoD appropriations by examining historical outlay rates, then determining the percentage outlaid in the year the funding was appropriated and in each subsequent year. The application of these outlay profile multipliers to the GDPPI creates most DoD-published indices, which remain inflation indices even after outlay profiles are applied.³⁰ Individual cost analysts and agencies may also apply these standard outlay rates to raw escalation indices from external sources (e.g., Producer Price Indices, National Reconnaissance Office indices), which were not produced with the spending profiles of DoD appropriations in mind.

TY\$ obs include escalation during the outlay period (see Chapter 2 section D), and CY\$ obs include real price change during the outlay period (see Chapter 2 section E). Outlays are not present in TY\$ exp, CY\$ exp, or CP\$. Only conversions to or from TY\$ obs require weighted indices—all other conversions require raw indices.

D. Does the index include all years required?

Indices vary in the length of time over which they measure price changes. Most DoD-provided indices include index values for many decades' worth of history, but only extend through the current FYDP or include one additional year beyond it (e.g., indices published in 2020 may not extend beyond 2024 or 2025). Because many program estimates have requirements beyond the FYDP, analysts must usually apply long-term assumptions to extend the index to cover all years required.

While professional forecasts are preferred, you will at times need to develop your own to cover all years in your estimate. To do so, you will have to select an annual rate of

should be treated as weighted indices. See previous footnote on exercising caution when using composite indices.

²⁹ Appropriations that are expended entirely during the year of obligation, such as military pay, civilian pay, and fuel (i.e., "one-year money"), have outlay profiles of 100% in the first year. In these cases, the raw and weighted indices are the same.

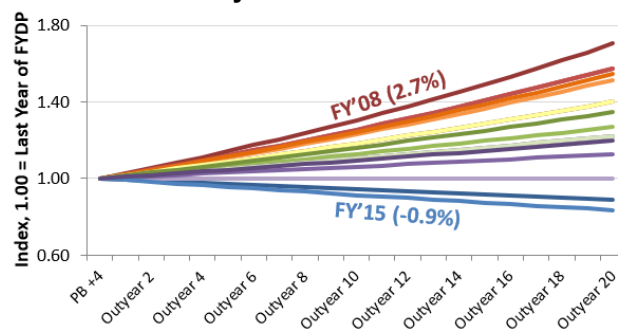
³⁰ If you believe that funds will be expended in a different outlay pattern than that represented by any DoD index, you may develop a custom outlay profile and use it to create a custom weighted index. See Chapter 7 section E for more information on building a weighted index.

change to apply to the years beyond the scope of the index, and should choose those rates with the goal of optimizing the realism and stability of the estimate. There is no “right way” to forecast a price index; one option is to use a line-of-best-fit from historical data, or another is to carry forward the average rate from completed years. See Chapter 7 section D for detailed instructions on how to extend an index to future years.

Another alternative is the risky but common practice of applying the annual rate of change from the last year of the FYDP to all subsequent years. For example, if the forecasted escalation rate for the fuel appropriation in the fifth and final year of the FYDP were 1.00 percent, you could (but perhaps should not) assume annual 1.00 percent escalation for fuel in the sixth, seventh, and eighth years, and beyond. Neither the Office of Management and Budget nor OUSD (Comptroller) currently require analysts to extrapolate price change assumptions for the last year of the FYDP into out-years beyond the scope of the guidance. This practice may cause disruptive changes in cost estimates that are updated annually, based solely on updating forecasted values that have a fair amount of uncertainty. Cost analysis organizations should consider whether changing post-FYDP escalation rates frequently leads to sufficient improvements in estimate accuracy to justify this “whiplash” effect on total costs.

Estimates that span long periods of time (such as sustainment) and estimates for commodities with volatile prices (such as fuel) are particularly vulnerable to even small fluctuations in index values. For example, between fiscal years 2001 and 2016, the fuel escalation rate in the last FYDP year ranged between -0.9 percent and 2.7 percent. Extrapolation of these rates over a twenty year window, shown in Figure 6-3, can create substantially different conclusions about future price levels. Similarly, a later example in Figure 8-3 shows that the use of different escalation rates—whether from using a different index source or indices representing different cost content—drives larger estimate deltas over long periods of time.

Figure 6-3. Extrapolating fuel prices using last year of FYDP.



7. Calculations and Examples

Inflation and escalation calculations require three major components: input, output, and index. The previous chapters described in detail the processes required to understand these components and treat them correctly in calculations—this chapter will describe the calculations themselves. The first section contains general instructions for converting inputs to outputs, and later sections describe additional calculations that may be required in certain cases.

A. General instructions

Follow this checklist to complete generic calculations for inflation and escalation, and refer to previous chapters as needed to ensure your inputs and outputs are classified correctly. Some parameters (in *italics*) may need additional preparation before you can use them, as described in later sections.

1. Identify *Input* value.
2. Identify input value type (TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, or CP\$). See Chapter 4 for detailed instructions.
3. Identify fiscal year of the input cost (*Year_{in}*). The input value may represent a single fiscal year (i.e., obligated in a single year, expended in a single year, or normalized relative to a single year), or it may represent multiple fiscal years (e.g., contract costs over a three-year period, or contract costs over an eight-month period that crosses fiscal years).
 - a. If the input value spans multiple fiscal years, you must select a single fiscal year to represent the value in further calculations. See section B below for further instructions.
 - b. For TY\$ inputs, *Year_{in}* is the transaction year. For CY\$ and CP\$ inputs, *Year_{in}* is the base year (e.g., an FY21 cost normalized to CY18\$ has a *Year_{in}* of 2018).
4. Select desired output type (TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, or CP\$). See Chapter 5 for detailed instructions.
5. Identify desired fiscal year of output value (*Year_{out}*). For TY\$ outputs, *Year_{out}* is the transaction year. For CY\$ and CP\$ outputs, *Year_{out}* is the base year.
6. Select an index that is appropriate for the type(s) of good(s) and/or service(s) included in the input value (e.g., aircraft procurement, operations and

maintenance, steel, etc.), and for the type of conversion to be executed (i.e., escalation or inflation). See Chapter 6 for detailed instructions.

- a. Identify the index value ($Index_{in}$) for $Year_{in}$ as determined in step 3. If the input value is TY\$ obs, make sure to use a weighted index; otherwise, use a raw index.
 - b. Identify the index value ($Index_{out}$) for $Year_{out}$ as determined in step 5. If the output value is TY\$ obs, make sure to use a weighted index; otherwise, use a raw index.
7. Multiply the *Input* by $Index_{out}$ and divide by $Index_{in}$ to calculate the *Output*:
- $$Input * \frac{Index_{out}}{Index_{in}} = Output$$
- ...where $Index_{in}$ and $Index_{out}$ are functions of the dollar types, years, and qualitative content (i.e., good(s) and/or service(s) represented) of the input and output, respectively, as described above.
8. Label your results clearly so other analysts can follow these instructions and obtain the same result. See Chapter 9 for best practices in documenting inflation and escalation calculations.

If you are completing these calculations as part of a dynamic cost model (as opposed to a quick-turn calculation for only a few inputs), you should consider modeling methods that will allow you to apply this process simultaneously to many inputs, across many years, and using multiple indices. For example, the VLOOKUP, INDEX, and MATCH functions in Microsoft Excel can automatically identify the relevant values in indices based on a selected index name and year across your model. You should also consider modeling techniques that will allow you to change selected indices, desired base years (for CY\$ and CP\$ outputs), and any other parameters for which you made decisions so that you can change them easily at any time.

B. Working with multi-year or cross-year input values

You may occasionally work with input values that span multiple years, and therefore have multiple options for the $Year_{in}$ parameter described in the instructions above. For example:

- Total FYDP Budget (FY16-20) = \$X: these are TY\$ obs spread over a five-year period.³¹

³¹ Note that, for the purposes of this section, an obligation in a given year is not considered a “multi-year cost.” Although an obligation will be expended over multiple years, there is no ambiguity in the year to which costs are assigned. You will use the year of obligation as $Year_{in}$ for subsequent calculations, and

- Total contract value (FY18-20) = \$X: these are TY\$ exp spread over a three-year period.
- Total life cycle cost estimate (FY11-20) = \$X: these costs may be any value type (see data label in estimate, if available) spread over a 10-year period.

Ideally, when dealing with inputs such as those in the examples above, you will be able to find an alternative data source that breaks out the multi-year costs into individual years. If you are unable to obtain annual data, you will need additional data sources to better characterize the timing of costs during the multi-year period for further calculations. Without this additional step, there is no clear way to align the costs with indices since indices typically measure annual or quarterly rates of change.

Some data that may help you understand the timing of costs within a multi-year range include labor hours, material invoices, earned value management data sources (e.g., Contractor Performance Reports [CPRs]), Cost and Software Data Reports (CSDRs), appropriation-specific outlay profiles, and subject matter expert opinion. You can convert these types of data into distributions with which to allocate the multi-year costs to individual years within the range, or, especially when using qualitative phasing data such as subject matter expert opinion, to a single year (e.g., “assign 100 percent of costs to the midpoint year of the range”).

It is always better to obtain annual cost data rather than using an allocation method, as any assumed phasing profile may assign some costs to years in which they did not or will not occur. Any further calculations to convert those misaligned costs to different types of dollars or different base years will capture more or less price change than intended.

Figure 7-1 below shows how you can obtain different results when normalizing data based on the phasing profile chosen to allocate a multi-year cost to individual years. In this example, a contract spanning FY18-20 is treated as a TY\$ exp; the analyst identified five possible phasing profiles³² relevant to the contract, allocated the total cost to individual years using each profile, and then converted each year’s cost to CY15\$ exp.

the use of a weighted index (when appropriate) will automatically adjust for the fact that funds will actually be expended over multiple years.

³² In reality, you are unlikely to find such a wide variety of phasing profiles for a single cost input. The profiles shown here simply demonstrate some of the patterns you may observe in phasing profiles, and show the potential for distortion if you select a phasing profile that does not closely reflect the actual (though unknown) phasing profile.

Figure 7-1. Example: Applying phasing profiles to multi-year costs.

Task: Given a \$100,000 contract expended from FY18-20, convert contract cost to CY15\$.

$$TY_{exp, phasing\ year} * \frac{Index_{2015} = 1}{Index_{phasing\ year}} = CY15\$$$

	Inflation Index (Notional)
2015	1.00000
2016	1.02000
2017	1.04040
2018	1.06121
2019	1.08243
2020	1.10408

The input (contract cost) does not have an index value directly associated with it because it spans multiple years. You must determine how much of the total cost was spent in each year (FY18, FY19, and FY20), then convert each year's costs (TY\$ expenditures, as provided) to CY15\$ using the index above.

The table at right shows five possible options for allocating the total cost to individual years. Data such as these could be obtained from many available sources, such as labor hours, material invoices, outlay profiles, etc., and converted to percentages if necessary. The sources of this sample data are not specified, and are for illustrative purposes only.

Notice the differences in results depending on the phasing profile selected. You should research the phasing applicable to your estimate to obtain a representative allocation of costs.

Possible Phasing Profile	TY\$ Phasing	Index	CY15\$
Profile #1 (midpoint year)	FY18 = \$ 0 /	1.06121	= \$0
	FY19 = \$ 100,000 /	1.08243	= \$92,385
	FY20 = \$ 0 /	1.10408	= \$0
	Total CY15\$ = \$92,385		
Profile #2 (front-loaded)	FY18 = \$ 60,000 /	1.06121	= \$56,539
	FY19 = \$ 30,000 /	1.08243	= \$27,715
	FY20 = \$ 10,000 /	1.10408	= \$9,057
	Total CY15\$ = \$93,312		
Profile #3 (back-loaded)	FY18 = \$ 10,000 /	1.06121	= \$9,423
	FY19 = \$ 30,000 /	1.08243	= \$27,715
	FY20 = \$ 60,000 /	1.10408	= \$54,344
	Total CY15\$ = \$91,482		
Profile #4 (normal dist.)	FY18 = \$ 15,000 /	1.06121	= \$14,135
	FY19 = \$ 70,000 /	1.08243	= \$64,669
	FY20 = \$ 15,000 /	1.10408	= \$13,586
	Total CY15\$ = \$92,390		
Profile #5 (uniform dist.)	FY18 = \$ 33,000 /	1.06121	= \$31,097
	FY19 = \$ 34,000 /	1.08243	= \$31,411
	FY20 = \$ 33,000 /	1.10408	= \$29,889
	Total CY15\$ = \$92,396		

The different results for each phasing option in Figure 7-1 show that a poor selection of phasing profile can distort the results of calculations. For example, if you chose Profile #2 and later discovered that the costs more closely followed Profile #3, your CY15\$ result would be overstated by two percent. The magnitude of this distortion depends on the relationships among the allocation year, the true distribution of costs over time, and the rate of change. You should attempt to characterize cost profiles as accurately as possible, and recognize the potential impact of any uncertainty in your phasing assumptions.

The allocation method described above can also serve as a template when adjusting for differences in accounting systems, particularly for contract data. For example, even a 12-month contract may not align perfectly with the government fiscal year (GFY), such as a contract with a period of performance from 7/1/2019 to 6/30/2020. The expenditures represented on any final cost reports for this contract would not align with indices designed for the GFY (such as those provided by DoD sources) or calendar year (provided by external sources), so you may wish to treat the costs occurring in different time periods with different indices. If you wish to use an index aligned to the GFY, you should attempt to distinguish the contract's costs occurring from 7/1/2019 to 9/30/2019

from those occurring from 10/1/2019 to 6/30/2020, and use index values with a $Year_{in}$ of 2019 for the former and 2020 for the latter. If you wish to use an index aligned to the calendar year, you should instead separate the costs at the boundary of the calendar year (in this example: 7/1/2019 to 12/31/2019 costs have a $Year_{in}$ of 2019, and 1/1/2020 to 6/30/2020 costs have a $Year_{in}$ of 2020).

A final potential application of the allocation process described above is to “convert” obligations to expenditures. Obligations and expenditures are fundamentally different measures of then-year costs, so attempts to convert between them are not as straightforward as other calculations described in this handbook—they require analytical assumptions, not simple look-ups. However, if you assume that an appropriation-specific outlay profile will accurately reflect the expenditure rate for an obligation, you can use the outlay profile percentages to phase the obligation year’s costs into the years in which funds are likely to be expended. You can also do the reverse, “converting” expenditures to assumed obligations by collapsing the expenditures down into the year in which they were most likely obligated, given typical outlay patterns. See Chapter 6 section A.5 for more information.

C. Basic sample calculations

This section shows some simple examples of inflation and escalation calculations. Given the notional indices provided, see the questions and answers at the end of this section for practice. Imagine that you obtained the following (notional) indices from a tool endorsed by your organization (left-side table of Figure 7-2). You observe that the base year of all of those indices is 2020, and that the GDP Price Index matches the raw indices for DoD RDT&E and DoD Aircraft Procurement, meaning that they represent inflation only (even though their names appear more customized). The raw Military Pay index is different from the GDP Price Index, meaning that it represents escalation for that commodity, and the weighted Military Pay index is the same as the raw, indicating that there are no outlays (i.e., the index represents one-year money). You also obtained an index from the Bureau of Labor Statistics (right-side table of Figure 7-2), which has a base year of 2015.

Figure 7-2. Indices for sample questions below.

(all indices notional)	GDP Price Index	DoD RDT&E		DoD Aircraft Procurement		Military Pay		Commercial Aircraft Procurement (Bureau of Labor Statistics, BY=2015, notional)			
		Raw	Weighted	Raw	Weighted	Raw	Weighted				
2015	0.9057	0.9057	0.9248	0.9057	0.9411	0.8626	0.8626	2015	1.0000	2031	1.4392
2016	0.9238	0.9238	0.9432	0.9238	0.9599	0.8885	0.8885	2016	1.0234	2032	1.4723
2017	0.9423	0.9423	0.9621	0.9423	0.9791	0.9151	0.9151	2017	1.0469	2033	1.5062
2018	0.9612	0.9612	0.9814	0.9612	0.9987	0.9426	0.9426	2018	1.0710	2034	1.5408
2019	0.9804	0.9804	1.0010	0.9804	1.0187	0.9709	0.9709	2019	1.0955	2035	1.5762
2020	1.0000	1.0000	1.0210	1.0000	1.0391	1.0000	1.0000	2020	1.1207	2036	1.6125
2021	1.0200	1.0200	1.0414	1.0200	1.0599	1.0300	1.0300	2021	1.1465	2037	1.6496
2022	1.0404	1.0404	1.0622	1.0404	1.0810	1.0609	1.0609	2022	1.1728	2038	1.6875
2023	1.0612	1.0612	1.0835	1.0612	1.1027	1.0927	1.0927	2023	1.1998	2039	1.7263
2024	1.0824	1.0824	1.1052	1.0824	1.1247	1.1255	1.1255	2024	1.2274	2040	1.7660
2025	1.1041	1.1041	1.1273	1.1041	1.1472	1.1593	1.1593	2025	1.2556	2041	1.8067
2026	1.1262	1.1262	1.1498	1.1262	1.1702	1.1941	1.1941	2026	1.2845	2042	1.8482
2027	1.1487	1.1487	1.1728	1.1487	1.1936	1.2299	1.2299	2027	1.3141	2043	1.8907
2028	1.1717	1.1717	1.1963	1.1717	1.2174	1.2668	1.2668	2028	1.3443	2044	1.9342
2029	1.1951	1.1951	1.2202	1.1951	1.2418	1.3048	1.3048	2029	1.3752	2045	1.9787
2030	1.2190	1.2190	1.2446	1.2190	1.2666	1.3439	1.3439	2030	1.4068	2046	2.0242

- Question:** Given a historical data point of \$107M for RDT&E (obligated in 2017) on an analogous program, what would be the cost for similar work scope for an obligation in 2024?

Observations: This is a TY\$ obs to TY\$ obs conversion. You will need a weighted index to go with the input, and another to go with the output. You will use the DoD RDT&E index provided because you believe it is a good match for the cost element content, even though it does not include real price change (i.e., you assume the cost element will experience zero real price change).

Answer: $\$107\text{M} / 0.9621 * 1.1052 = \$123\text{M}$

- Question:** An analogous aircraft procurement program's CSDR data shows expenditures of \$53,312 in 2016; \$54,619 in 2017; and \$55,872 in 2018. What were the average annual expenditures in 2020 dollars?

Observations: The inputs are TY\$ exp, so we will use a raw index first. However, the question is somewhat vague... what kind of "2020 dollars" should the output be, and what index will get us there? We know (from Chapter 5) that averages should be computed in CP\$, so let's use the notional BLS Commercial Aircraft Procurement index (escalation) to produce a CP20\$ output. The first step will convert each expenditure to CP15\$ (with the base year of the index), and the second to CP20\$ (with the desired base year).

Answer:

2016: $\$53,312 / 1.0234 = \$52,093$ (CP15\$) * 1.1207 = \$58,381 (CP20\$)
2017: $\$54,619 / 1.0469 = \$52,172$ (CP15\$) * 1.1207 = \$58,469 (CP20\$)
2018: $\$55,872 / 1.0710 = \$52,168$ (CP15\$) * 1.1207 = \$58,465 (CP20\$)
Sum (2016-2018, CP20\$) = \$175,315; Average = Sum / 3 = \$58,438

Alternative Calculation: You could also calculate the average in CP15\$ (\$52,143) and convert that to CP20\$ with the raw index for 2020:

$$\text{Average (2016-2018)} = \$52,144 \text{ (CP15\$)} * 1.1207 = \$58,438 \text{ (CP20\$)}$$

Further Observations: Notice that the CP20\$ value for each transaction year is quite close to the average; this is a good indicator that the index selected (here, the BLS procurement option) was a good match for the trends observed in the historical data. If there were significant upward or downward trends remaining after normalizing to CP\$, or if a step function or other pattern is observed, it may indicate that the index selected is not adequately capturing the price trends. In such a scenario, you may need to find another index or look for further ways to normalize your data (e.g., quantity changes).

3. **Question:** Given a military member's salary of \$120,000 in FY 2020, what will the person's salary be in FY 2030, in TY\$ and CY20\$?

Observations: We will disregard outlays for this example because military pay is one-year money,³³ so we will use only raw indices. Our input is TY\$ (we can treat this as either obligations or expenditures due to the exclusion of outlays) because it represents a real-world transaction (payments to the employee). To convert our TY\$ in 2020 to TY\$ in 2030, we will escalate the value to TY\$ for a future transaction year using the military pay index, then remove inflation from the result using the GDP Price Index to produce a CY20\$ output (for the same transaction year).

Answer:

$$\text{TY\$ in 2030} = \$120,000 * 1.3439 = \$161,268$$

$$\text{CY20\$ in 2030} = \$161,268 / 1.2190 = \$132,295$$

Interpretation: What does the CY20 \$132,295 result represent? If the 2030 salary has been normalized to a base year of 2020, why did we not get the same \$120,000 salary for 2020 that we started with? The difference of \$12,295 represents the real price change the salary experienced between 2020 and 2030; the person making \$161,268 in 2030 would have the relative buying power *in 2030* of a person making \$132,295 *in 2020*, not the same relative buying power as a person making \$120,000 *in 2020*. This is where the difference between CY\$ and CP\$ comes into play; if we

³³ For some applications, military pay and civilian pay do exhibit outlay profiles to account for delays in benefits payments. For the purposes of this example, and to match the standard practice for many cost estimates, we will treat military pay as one-year money.

had converted the 2030 salary (\$161,268) to CP20\$ instead, we would have divided it by the same military pay index (1.3439) that produced it, yielding the familiar \$120,000. These values mean different things and are useful for different analyses, as discussed in Chapter 5.

D. Making custom indices

You may want to use a particular escalation rate for which you cannot find an index, such as to match the average escalation rate observed in historical data or to conform to agency-wide best practices (e.g., “use X% compounding growth on top of inflation for depot level reparable prices”).

For however many years you require in your index, determine the annual escalation rate. If your custom index is based on research into real price change rates alone, you may need to use the multiplicative relationship between inflation and real price change (as shown in Chapter 2 section C) to calculate the total rate of escalation for each year before proceeding. The rate may be the same for all years in your index, or you may use different rates in different years depending on how you believe prices will change over time. You must also decide whether to apply escalation linearly or in a compounding manner, as shown in Examples 1 and 2 below, or you may manually enter index values for other patterns of price change (e.g., step functions) as shown in Example 3. Each of the first two examples includes two options for calculating the index, one based on the number of years since the base year of the index (Method 1) and one that builds upon the previous year’s index value (Method 2); you may only use Method 1 if you have a constant annual rate from the base year until the year for which you are calculating an index value.

Example 1. Element experiences 3.0% linear growth starting from FY21:

Index Year	Method 1 (blue = years since base year)	Method 2 (from previous index value)
FY21	$= 1.0000 * (0.03 * 0) + 1$ $= 1.0000$	$= 1.0000$
FY22	$= 1.0000 * (0.03 * 1) + 1$ $= 1.0300$	$= 1.0000 + 0.03$ $= 1.0300$
FY23	$= 1.0000 * (0.03 * 2) + 1$ $= 1.0600$	$= 1.0300 + 0.03$ $= 1.0600$
FY24	$= 1.0000 * (0.03 * 3) + 1$ $= 1.0900$	$= 1.0600 + 0.03$ $= 1.0900$
FY25	$= 1.0000 * (0.03 * 4) + 1$ $= 1.1200$	$= 1.0900 + 0.03$ $= 1.1200$

Example 2. Element experiences 3.0% compounding growth starting from FY21:

Index Year	Method 1 (blue = years since base year)	Method 2 (from previous index value)
FY21	= 1.0000 * (1+0.03) ⁰ = 1.0000	= 1.0000
FY22	= 1.0000 * (1+0.03) ¹ = 1.0300	= 1.0000 * 1.03 = 1.0300
FY23	= 1.0000 * (1+0.03) ² = 1.0609	= 1.0300 * 1.03 = 1.0609
FY24	= 1.0000 * (1+0.03) ³ = 1.0927	= 1.0609 * 1.03 = 1.0927
FY25	= 1.0000 * (1+0.03) ⁴ = 1.1255	= 1.0927 * 1.03 = 1.1255

Example 3. Element has negotiated fixed prices for FY21-23, followed by a one-time increase of 3.0% from the previous price, which will apply in FY24-25. Index patterns such as these can be entered manually:

Index Year	Index Value
FY21	= 1.0000
FY22	= 1.0000
FY23	= 1.0000
FY24	= 1.0300
FY25	= 1.0300

You may also make custom composite indices according to the instructions above, with the added step of combining multiple indices in the desired proportions. To do this, determine the relative proportions of the indices to be included in the composite and calculate a weighted average of the indices (not to be confused with a “weighted index” as described in the next section, which is a single index that is weighted across the outlay period).

After you have created your custom raw index, determine whether you require a weighted index and, if so, identify an outlay profile that reflects the expected phasing of expenditures over time. The next section includes instructions for applying an outlay profile to a raw index to create a weighted index.

E. Making weighted indices

As described in Chapter 6, weighted indices apply outlay profiles to raw indices³⁴ to account for the fact that obligations may not be fully expended in the year in which they are labeled in a budget document or cost estimate. Outlay profiles are based on historical expenditure rates for obligations in each major DoD appropriation, and are published annually by the Office of the Under Secretary of Defense (Comptroller) in the President's Budget Green Book, Chapter 5.

The formula to produce a weighted index appears complex at first glance because it combines several mathematical steps into a single multiplier for ease of use. This section will first explain the denominator on its own, followed by the overall formula. The formula is best understood through examples, but the overall formula is as follows:

$$W_t = \frac{1}{\sum_{i=t}^n \left(\frac{P_{i-t}}{R_i} \right)} = \frac{1}{\frac{P_0}{R_t} + \frac{P_1}{R_{t+1}} + \frac{P_2}{R_{t+2}} + \dots + \frac{P_{n-t}}{R_n}}$$

Definitions: W_t = weighted index value for year t
 P_{i-t} = outlay rate for year $i-t$ of outlay profile
 R_i = raw index value for year i
 t = year requiring weighted index value
 $n - t + 1$ = number of years in outlay profile

Note: The number of terms in the denominator will be equal to the number of years in the outlay profile.

1. Understanding the denominator of the weighted index formula

The purpose of the denominator in the weighted index formula is to measure the aggregate change in the value of funds over the course of the outlay profile. In other words, the denominator accounts for the fact that each portion of an obligation that is expended in subsequent years will have different buying power than the portion expended in the year of obligation. Each term in the denominator divides those portions (which represent different buying power) by the raw index for that year, thereby restating the outlay profile in terms of equivalent buying power (in the base year of the index). The summation of these terms measures the aggregate loss (in the case of positive escalation) or gain (in the case of negative escalation) of buying power, phased appropriately for the

³⁴ This handbook recommends creating weighted indices for only inflation or escalation. Although it is possible to find or create raw indices that measure only real price change, and to further apply outlay profiles to create weighted versions, the use of raw and weighted real price change indices is inadvisable. Even when used correctly, conversions using weighted real price change indices (such as to convert between CP\$ and CY\$ obs directly) produce slightly different results than the conceptually equivalent conversions that go through a TY\$ obs intermediate (see Chapter 6 section A) due to order-of-operations issues.

expected timing of costs. For example, assume a raw index (Base Year 0) and a three-year outlay profile with the following values:

Raw index:	Outlay profile:
$R_0 = 1.0000$	$P_0 = 20\% = 0.20$
$R_1 = 1.0200$	$P_1 = 50\% = 0.50$
$R_2 = 1.0404$	$P_2 = 30\% = 0.30$
$R_3 = 1.0612$	
$R_4 = 1.0824$	

The denominator to calculate the weighted index value for the base year (Year 0) is provided below, with each term labeled with a letter for further description:

$$\text{Denominator of } W_0 = \frac{0.20}{1.0000} + \frac{0.50}{1.0200} + \frac{0.30}{1.0404} = 0.2000 + 0.4902 + 0.2884 = 0.9786$$

Item: **A** **B** **C** **D** **E** **F** **G**

Item	Narrative description
A	20% of the obligated amount will be spent in a year with buying power equivalent to that of the obligation year.
B	50% of the obligated amount will be spent in a year requiring 1.0200 times the buying power of the obligation year.
C	30% of the obligated amount will be spent in a year requiring 1.0404 times the buying power of the obligation year.
D	20% of the obligated amount is still worth 20.00% by the time it is expended from the Treasury.
E	50% of the obligated amount is worth only 49.02% by the time it is expended from the Treasury.
F	30% of the obligated amount is worth only 28.84% by the time it is expended from the Treasury.
G	In aggregate, the obligated amount is worth only 97.86% of its value by the time it is expended from the Treasury.

In this example, each dollar obligated would only purchase 97.86 cents' worth of goods and services due to the decrease in the value of the obligated funds.

2. Understanding the overall structure of the weighted index formula

The weighted index formula takes the inverse of the calculated change in buying power (shown in the previous section) to create a multiplier that compensates for it. In other words, the multiplier will adjust the value to be obligated to ensure that it will include sufficient funds to pay for a decrease in buying power (for positive escalation) and exclude unnecessary funds if an increase in buying power is anticipated (for negative escalation). To continue the example from the previous section:

$$W_0 = \frac{1}{0.9786} = \frac{1.0219}{1}$$

Item: **H** **J**

Item	Narrative description
H	Each dollar obligated will purchase 97.86 cents' worth of goods/services over the defined outlay period. A program using this appropriation may only be able to purchase 97.86% of its desired goods/services if it does not account for the expected decrease in buying power over the outlay period.
J	To purchase one dollars' worth of goods/services over the defined outlay period, \$1.0219 must be obligated. A program using this appropriation should obligate 1.0219 times what the cost would have been if expended entirely in the year of obligation.

Follow the above instructions to calculate weighted index values for each year required. For example, the weighted index values for the next two years in the above example would be:

$$W_1 = \frac{1}{\frac{0.20}{1.0200} + \frac{0.50}{1.0404} + \frac{0.30}{1.0612}} = \frac{1}{0.9594} = 1.0423$$

$$W_2 = \frac{1}{\frac{0.20}{1.0404} + \frac{0.50}{1.0612} + \frac{0.30}{1.0824}} = \frac{1}{0.9406} = 1.0632$$

F. Changing the base year of an index

The base year of an index is the year relative to which price change is measured for all other years. For raw indices, the index value will be 1 for the base year. For weighted indices with an outlay profile of more than one year, the index value for the base year will be greater than or less than 1 to account for the price change during the outlay period.

The year to which an index is baselined does not affect escalation calculations directly because the ratio of $Index_{out}$ to $Index_{in}$ in the equation in section A will be the same regardless of the index base year.³⁵ Because changing the base year of an index will not change your results, you may wish to do so to match the base year of your estimate or to match the base year of another index for comparison.

³⁵ Note that the example provided in this section does not perfectly demonstrate this relationship because the index values have been rounded for display purposes. In practice, you should maintain as many decimal places as possible in all uses of indices. For weighted indices, this calculation will capture annual changes and year-to-year changes in the outlay profile itself.

To change the base year of any raw index, simply divide every value in the index by the index value for the desired base year as shown in Figure 7-3. The example below shows an index with an original base year of 2018 and the calculations required to change the base year to 2021. Note that the year-over-year rate of change is the same regardless of the index base year. You cannot perform this procedure on weighted indices—you would have to adjust the raw index first and then reapply the outlay profile (which may vary from year to year) to create a new weighted index.

Figure 7-3. Re-baselining a raw index.

Index Year	Original Index (Base Year 2018)	Change from Prev. Year	Calculation to Change Base Year to 2021	New Index (Base Year 2021)	Change from Prev. Year
FY16	0.9382	N/A	$0.9382/1.0980=$	0.8544	N/A
FY17	0.9804	4.5%	$0.9804/1.0980=$	0.8929	4.5%
FY18	1.0000	2.0%	$1.0000/1.0980=$	0.9107	2.0%
FY19	1.0300	3.0%	$1.0300/1.0980=$	0.9380	3.0%
FY20	1.0609	3.0%	$1.0609/1.0980=$	0.9662	3.0%
FY21	1.0980	3.5%	$1.0980/1.0980=$	1.0000	3.5%
FY22	1.1365	3.5%	$1.1365/1.0980=$	1.0350	3.5%
FY23	1.1819	4.0%	$1.1819/1.0980=$	1.0764	4.0%
FY24	1.2292	4.0%	$1.2292/1.0980=$	1.1195	4.0%
FY25	1.2784	4.0%	$1.2784/1.0980=$	1.1642	4.0%

8. How to Minimize Errors and Bias

The instructions provided in the previous chapter involved many inputs, any of which could contain errors or biases that would affect the results of escalation calculations. Even small variances in inflation and escalation inputs can influence total costs, particularly for estimates over long time periods or that involve goods and services with high rates of price change (either positive or negative). Underestimating escalation can lead to a significant loss of buying power as a program proceeds through its life cycle, and overestimating escalation could overcommit resources that could fund other priorities instead.

This chapter will highlight the difference between making an avoidable mistake in calculations and making an assumption that will bias your results. You may not always have all the information you require to complete the instructions in the previous chapter, and will have to fill in the gaps with the best information you have. You should seek to understand and document whether your assumptions are more likely to over- or underestimate costs, and provide that information to decision makers when it could affect their decisions.

Note that the original input value (as characterized in Chapter 4) can be a source of error or bias in and of itself; refer to the Joint Agency Cost Schedule Risk and Uncertainty Handbook (JA CSRUH)³⁶ for a complete discussion of risk and uncertainty in cost estimating.

A. Avoiding avoidable errors

The “avoidable” errors listed here should be fairly easy to catch in reviewing your cost model, or when presenting detailed results to a peer reviewer or your supervisor. They may occur due to improper cell references in a spreadsheet, or due to the misapplication of definitions and instructions provided in this handbook. Some of the simplest, most easily avoidable errors are as follows:

- Multiplying by an index when you should have divided, or vice versa
- Capturing inflation instead of escalation, or vice versa; may result from:
 - Incorrect interpretation of an input value (e.g., treating a budgeted value, which is actually TY\$ obs, as though it is CY\$ obs)
 - Improper selection of desired output type (e.g., producing a CY\$ obs value for use in a budget exhibit meant to represent TY\$ obs)

³⁶ <https://www.ncca.navy.mil/tools/csruh/index.cfm>

- Misunderstanding the scope of price change included in the selected index (e.g., using a MILPAY index to convert a TY\$ to a desired CY\$ output would actually produce a CP\$)
- Using an inappropriate formula to represent the expected escalation trend (e.g., compound instead of linear growth, or vice versa)
- Mathematical errors in creating custom indices
- Failure to complete a sanity-check on results; for example:
 - Using an index with negative escalation in perpetuity, in such a way that total costs become negative (i.e., the item not only becomes free, but DoD appears to be paid for purchasing it such as in Figure 6-3)
 - Showing relationships between TY\$ and CY\$ that do not make sense given that the US economy generally does not experience deflation³⁷
 - Using an index that shows an escalation rate substantially different from that observed in historical data, or used in estimates for similar goods and services; note that you may have legitimate reasons to use a substantially different escalation rate (as history is not always a good predictor of the future), but you should ensure that any such divergence is intentional and well-documented as opposed to a typographical error (e.g., 20% instead of 0.20%)

Unlike the errors listed above, which should always be avoidable, some types of errors may be avoidable in some circumstances and unavoidable in others. The following list provides some examples of such errors and describes the circumstances under which they are *avoidable*, and the next section will go into more detail about how they could be sources of *unavoidable* bias.

- Using incorrect $Year_{in}$ or $Year_{out}$ values, as with incorrect cell references in a spreadsheet; this error would change the length of time over which inflation or escalation is measured. Note: This error may be unavoidable when you must calculate $Year_{in}$ from a range for a multi-year input, as described in Chapter 7. This error may also be unavoidable if you are using costs that were incurred outside the recorded period of a contract, for example if a

³⁷ When normalizing a TY\$ value to CY\$ for a given year, $TY\$ > CY\$$ for all years after the base year ($Index_{out} / Index_{in} > 1$), and $TY\$ < CY\$$ for all years before the base year ($Index_{out} / Index_{in} < 1$). This statement would be false only in the event of US-economy-wide deflation—the escalation rate of any specific commodity does not affect this relationship between TY\$ and CY\$ in any way. See Appendix C for graphics demonstrating this relationship.

contractor bulk-buys material for use in multiple contracts. See the next section on unavoidable bias in assumptions for more detail.

- Using an escalation index that represents goods and services that are not relevant to your estimate (e.g., using an aircraft procurement index to represent the escalation of military pay rates). If the index represents a substantially different rate of escalation than the goods and services you are actually estimating, you could over- or underestimate costs. Note: This error may be unavoidable if you are unable to find an index that appropriately represents the goods and services in your estimate. In this case, follow your agency's best practices, use the best index available, and try to analyze whether your program of interest is likely to experience escalation at a greater or lesser rate than that captured in the index you selected. See the next section on unavoidable bias in assumptions for more detail.
- Mixing dissimilar inputs (e.g., TY\$ and CY\$, or CY\$ for different base years) for calculations or comparisons. You should always make sure to normalize data consistently so that you are calculating or comparing values that are "apples to apples." Failure to do so would be comparable to adding values with different units, such as pounds and kilograms, because different input dollar types are effectively different units of measure. Note: This error may be unavoidable if you must use inputs that are not labeled, thereby forcing you to make assumptions about the dollar type, or if you must use inputs that have been normalized with an unknown index. See the next section on unavoidable bias in assumptions for more detail.

B. Understanding unavoidable bias

Cost estimators must frequently make assumptions to complete estimates when incomplete information is available. Any assumption can introduce bias into your estimate, depending on whether the assumed input is higher or lower than the true value. Following is a sample list of assumptions related to inflation and escalation, and the potential impact if they turn out to be incorrect.

- **Assumption:** "I had to use a multi-year input, so I calculated a $Year_{in}$ value based on the midpoint of the range. I know some costs were incurred in other years, but I don't know the time phasing."
Impact: The delta between $Year_{in}$ and $Year_{out}$ determines how many years' worth of inflation or escalation you capture in the conversion. Any difference between your assumed $Year_{in}$ and the true value would affect the amount of price change that is accounted for in any conversions.

- **Assumption:** “I had to use a multi-year input, so I allocated the costs to individual years based on supplemental data that may not represent the actual timing of costs incurred.”
Impact: Any conversions you make on costs that you allocated to an incorrect year will result in the application of either too much or too little price change, as described in the previous example.
- **Assumption:** “I chose an escalation index that I think is relevant to my estimate, but I don’t know for sure.”
Impact: The annual rate of change in the index you selected may be higher or lower than the rate that actually was or will be experienced. You may also double-count some real price change if the index represents cost drivers that you have already estimated discretely in your estimate, or the index may omit sources of real price change that are important to the goods or services in your estimate. The magnitude of this impact will depend on the delta between assumed and actual rate of price change, as well as the time period over which price change occurs.
- **Assumption:** “I need to compare my estimate to a cost metric published in CY\$, but I don’t know what inflation index produced the CY\$ value in the metric. I will just use the most recent inflation index because that’s the best data I have right now.”
Impact: Comparing values that were normalized using different indices will conflate differences between the indices with differences between other aspects of the values. If the goal of comparing normalized values is to remove the effect of inflation, using inflation indices from different publication years could result in index-driven deltas in the normalization process.

There are also certain sources of unavoidable bias in inflation and escalation that are inherent to all cost estimates. You may not need to document these biases for your estimate, but you should understand and consider these issues so you can communicate the resulting uncertainty to decision makers.

- Cost estimators often rely on historical data as the basis of future forecasts because it is readily accessible, accepting the fact that history may not be a perfect predictor of the future. Many professional market forecasts use economic indicators—rather than pure history—to project future economic conditions, but these indicators may be neither intuitive nor easy for a cost estimator with limited resources to identify. In the absence of professional forecast recommendations such as those based on futures markets, a best practice is to examine historical price change trends and use subjective information to assess whether the same trends are likely to continue, as

opposed to omitting real price change from estimates just because it is difficult to predict.

- Economic trends are not permanent, and the indices available to us may describe trends that will not last for the entire duration of weapon systems' long production timelines or life cycles. There is no way to predict how prices in any market will change over multiple decades—we must account for escalation over the full estimate period, knowing that the index values we apply for later years could be drastically different from the price change that will actually occur. This uncertainty is less significant for shorter estimate durations, but you should review the indices in your estimates regularly to ensure they remain aligned with economic forecasts, and update them when warranted.

C. Reaching valid conclusions

Failure to avoid avoidable errors or understand unavoidable biases can lead to invalid conclusions. This section will explain the possible pitfalls of presenting cost estimates to decision makers at an inappropriate level of normalization.

In general, cost values not only convey information about a specific program or cost element, but also help facilitate the comparison of disparate costs. While CP\$ is a useful level of normalization for calculations and for visualizing programmatic trends, it can provide a distorted view of differing programs or cost elements that are normalized with different escalation indices. In contrast, CY\$ obs provide a consistent normalization process because costs are normalized for inflation only, which is common to all programs and cost elements. Some analyses should also be presented in TY\$ obs so decision makers can view the full estimate. The following sections discuss some common types of cost comparisons: affordability analyses, comparing current and baseline costs, and comparing alternative purchases.

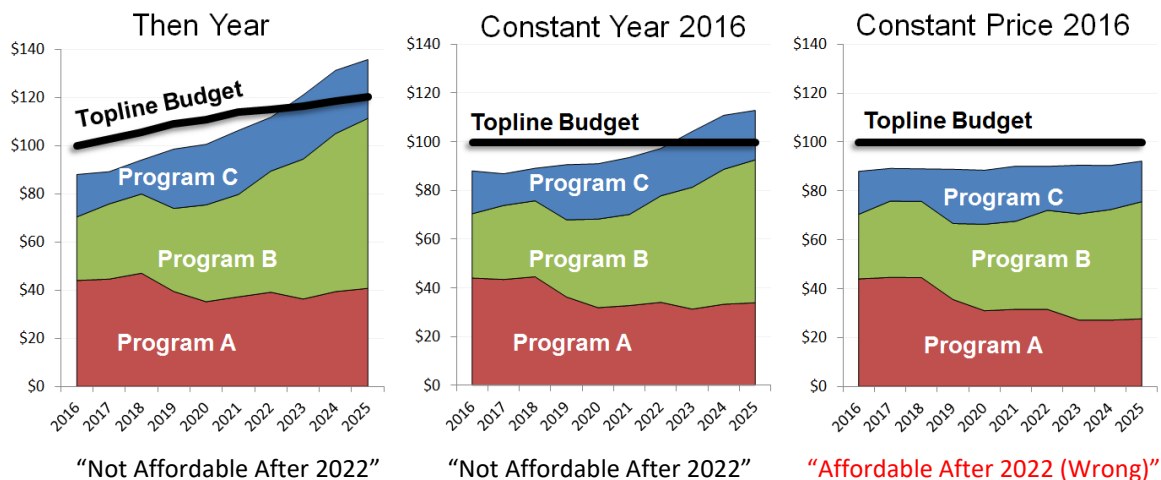
1. Affordability analysis

A reliable affordability analysis is critical to understanding whether program funding requirements fit under a future budget. An aggregate portfolio of cost estimates, combined with all other fiscal demands, must not exceed a reasonably projected topline budget. A reasonable projection of topline growth is inflation as measured by the GDPPI.

Suppose DoD is executing two programs, A and B, and wants to assess the affordability of a new program, C. The programs use a unique mix of market resources, the prices of which are expected to grow faster than the rate of overall inflation. Assume program cost estimates reflect realistic escalation assumptions, and that Program B demands more resources over time while Programs A and C demand fewer.

In the “Then Year” chart (TY\$ obs) on the left in Figure 8-1 below, the program funding requirements, which grow at rates of escalation specific to each program, surpass the budget projection, which grows at the rate of inflation, in the year 2022. The set of programs is no longer affordable, and the DoD will have to make tradeoffs to stay within the topline budget—an important observation to convey to decision makers who will be responsible for directing those tradeoffs. The same conclusion is evident in the “Constant Year 2016” chart (CY\$ obs), in which each program’s then-year costs and the topline budget are deflated using a common inflation index.

Figure 8-1. Comparing the budget to CP\$ portfolio costs can lead to misleading affordability conclusions.



However, suppose that a cost analyst, instead of displaying this analysis in TY\$ obs or CY\$ obs, puts each element of the affordability analysis into CP\$ using program-specific escalation indices. There is no comparable escalation index for the entire DoD budget beyond inflation, so the topline budget in the “Constant Price 2016” chart is not displayed in the same terms as programs A, B, and C; in other words, each program is normalized for escalation, but the topline budget is only normalized for inflation. The normalized costs for the programs appear to fit within the projected topline budget, but the types of dollars displayed are not comparable, and the analysis leads to an incorrect conclusion: the set of programs appears affordable after 2022 given their projected demands, when in fact it is not.

In summary, affordability analyses assess the cost impact of adding new program and budget elements to existing ones. Where elements have different escalation rates, CP\$ return distorted relationships. Costs for affordability analyses should be presented in TY\$ obs, CY\$ obs, or both. Costs for affordability analyses should not be presented in TY\$ exp or CY\$ exp because DoD budgets must account for outlay profiles.

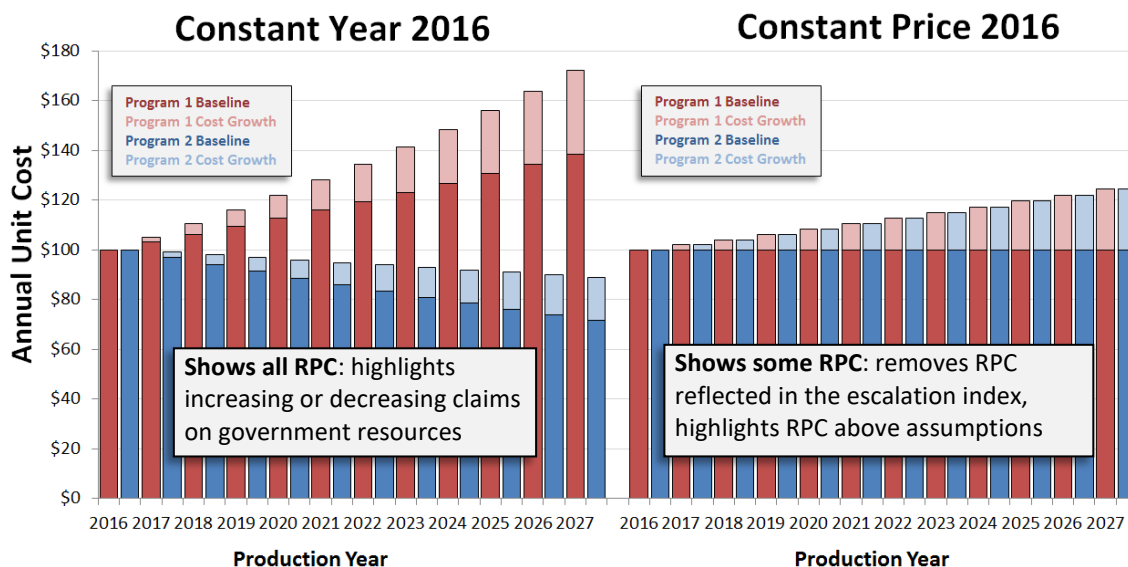
2. Comparing current and baseline costs

Program performance is often measured relative to a baseline cost objective, and growth above certain thresholds triggers additional controls and oversight. This handbook recommends that all costs related to program baselining be measured in CY\$ obs, for two primary reasons.

First, CY\$ obs are a shared focal point for all programs. Observers can immediately recognize that the dollars were normalized for only inflation, and draw the same interpretation. Constant prices can be created using an escalation index, but beg the question, “an escalation index of *what?*” An escalation index might measure the price change for a broad basket of goods, such as all aircraft manufacturing inputs, or a narrow basket, such as titanium. Proper interpretation of CP\$ requires further investigation into the escalation index, especially when dealing with multiple values that were normalized using different escalation indices from each other.

Second, and more importantly, CY\$ obs preserve the appearance of real price change, which is often important information for decision makers. Suppose two program baselines were estimated with different baseline escalation assumptions, one with a real price change of positive 3.0 percent and the other negative 3.0 percent. If both programs experienced annual escalation 2.0 percent above their corresponding baseline escalation assumptions, different views emerge in CY\$ obs and CP\$. A CY\$ obs profile (left-hand side of Figure 8-2 below) will reflect the fact that the second program demanded fewer real resources over time, despite experiencing cost growth, while the first demanded ever-increasing resources. The same data normalized to CP\$ (right-hand side of Figure 8-2 below) only shows performance to assumptions, or the fact that both programs experienced annual escalation of 2.0 percent above baseline.

Figure 8-2. Comparing program trends in CP\$ can lead to misleading conclusions.



Not only will the audience's perception of program costs differ depending on the method of cost conversion, but so will the calculated average unit cost escalation. While the percent escalation in Figure 8-2 is exactly the same between the two programs in CP\$, they differ in CY\$ obs. Because both programs experienced an equal 2.0 percent annual escalation above baseline escalation assumptions, they realized the same percentage cost growth in CP\$ (11.77%).³⁸ Yet when measured in CY\$ obs, Program 1 shows relatively higher cost growth and Program 2 relatively lower (12.55% and 10.97%, respectively). This differential occurs because Program 1 had assumed positive real price change in the baseline, while Program 2 assumed negative real price change. The higher baseline escalation assumptions translated into higher percent cost growth in CY\$ obs due to the effects of compounding growth.

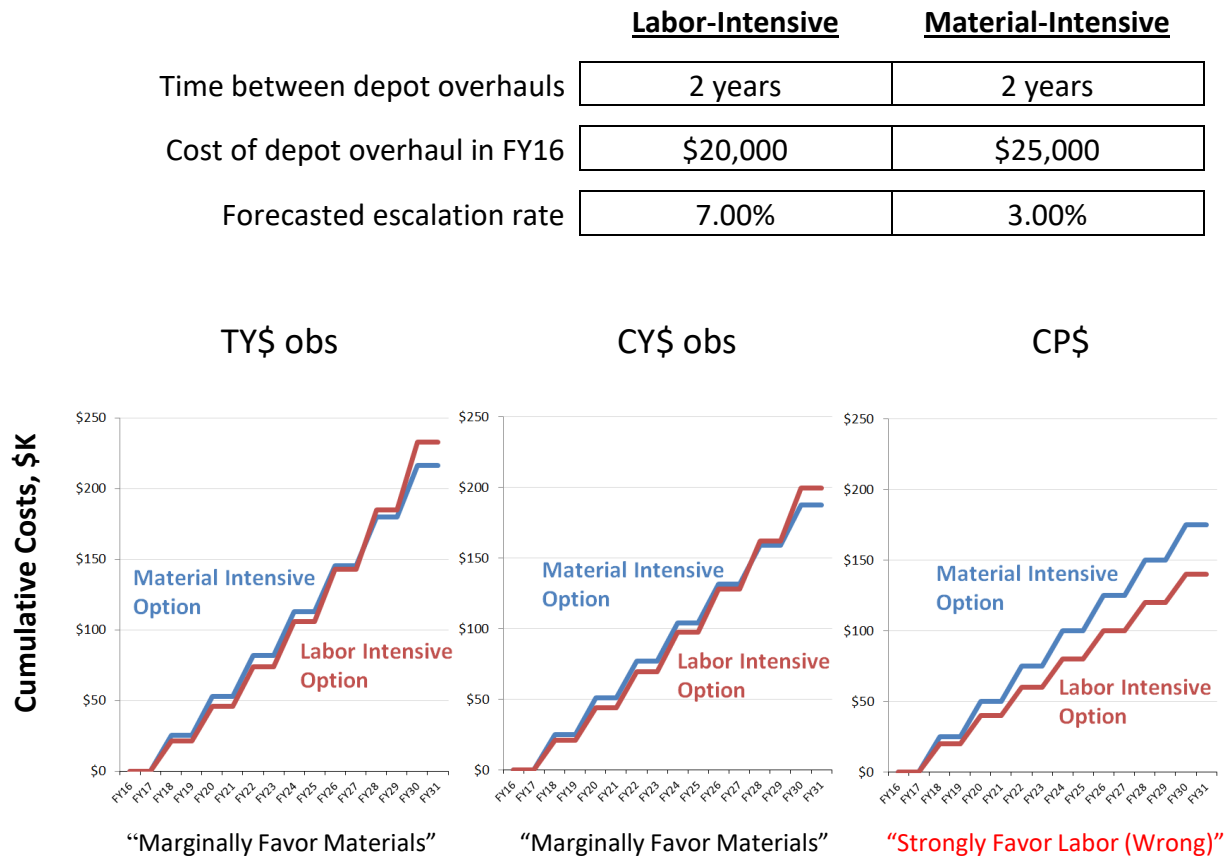
As shown in the example above, displaying results in CP\$ can lead to incorrect conclusions about the change in a program's cost over time. Every commodity—possibly every program—could use its own unique measure of success, choosing indices based on how they will influence decision makers' conclusions. Further, CP\$ analyses are not appropriate for decision makers' consideration of opportunity costs because, in considering trade-offs across multiple portfolios, there would be no common point of comparison for the actual dollars DoD has available. Also, as shown in the example programs, the choice of an escalation index could affect whether a program appears to represent decreasing demands on the DoD's budget (which allows for more programming) versus increasing demands (which may require cuts there or elsewhere).

3. Comparing alternative purchases

Programs often have multiple courses of action available to fulfill mission requirements. Decision makers must select the most effective alternative, taking into account differences in cost, schedule, and technical requirements. Consider the following example that focuses on aspects related to cost. A system that is deployed in FY16 can undergo depot overhauls in two-year cycles with equal reliability using either a "Labor-Intensive" option or a "Material-Intensive" option. Your task is to determine the most cost effective option over a 15-year timeframe and make a recommendation to decision makers.

³⁸ Had the programs used escalation indices that depended in large part on the programs in question, there would have been 0.00% cost growth in CP\$. Say that these programs represented the only purchases in their commodity group, and the escalation indices are derived from actuals from the programs in question. In this case, the final escalation indices would have incorporated the higher real price change than forecasted and normalized away any apparent cost growth. It was assumed here that the programs in question did not affect the realized escalation indices, which conformed to escalation forecasts at the time of the baseline.

Figure 8-3. Comparing alternative courses of action in CP\$ can lead to misleading conclusions about the least expensive option.



Which alternative would you recommend to decision makers? Over 15 years, the system would undergo seven overhauls under both alternatives. By correctly applying forecasted escalation (not inflation) to the current cost of each alternative, you will return cumulative TY\$ obs overhaul cost profiles (left chart of Figure 8-3 above). The 15-year sustainment costs are \$217K for the Material-Intensive option and \$233K for the Labor-Intensive option. In TY\$, the Material-Intensive option appears marginally more cost-effective.

Then-year dollars, however, are not appropriate for comparing alternatives with different expenditure patterns over time due to the fact that different options might use different escalation rates. Remember that the purchasing power of the dollar is also changing over time; to account for the difference in expenditures due to timing differences across options, the effects of the change in the dollar's purchasing power must be removed. Deflating the stream of overhaul costs for each alternative by a common inflation index returns CY\$ obs in the base year of FY16 (middle chart of Figure 8-3).

After deflating TY\$ obs to CY\$ obs, you calculate a Material-Intensive overhaul cost of \$188K and a Labor-Intensive cost of \$199K. The conclusion remains: the Material-Intensive option is marginally more cost-effective when viewed in CY\$ obs. However, TY\$ obs and CY\$ obs can often lead to different conclusions, which may have been the case in this example if the alternatives had different overhaul cycle times.

While TY\$ costs are best estimated utilizing escalation to account for all anticipated price changes, you should present alternative costs in CY\$ for comparisons because doing so preserves the effects of real price change, which often differ among alternatives. The Labor-Intensive option in this example is more expensive because its projected escalation rate is considerably higher than that for the Material-Intensive option. An analysis normalizing the TY\$ obs to CP\$ instead (right chart of Figure 8-3) would remove all real price change, distorting the comparison. De-escalating the Material-Intensive option with a 3.0 percent annual escalation index and de-escalating the Labor-Intensive option with a 7.0 percent annual escalation index would lead to the wrong conclusion because the resulting normalized estimates are not in comparable units. This CP\$ comparison incorrectly presents the Labor-Intensive option as significantly less expensive, as opposed to marginally more expensive, compared to the Material-Intensive option.

Constant-year dollars (CY\$ obs) are the appropriate units for presenting the stream of costs when comparing alternatives. Decision makers need to understand which alternative is more cost-effective after removing distortions to the purchasing power of the dollar caused by different expenditure timing. Constant prices do not include potentially important information about real price change, and therefore prohibit an accurate comparison of alternatives relative to actual resources demanded.

9. Documenting and Comparing Estimates

As with any other part of a cost estimate, you should document the assumptions and methodology used when applying inflation and escalation indices. Spreadsheets containing price-adjusted data should document input data, output types, and indices thoroughly so that a subsequent analyst can reproduce the results and, if necessary, perform updates. Preferably, you should include a full copy of the indices applied in your estimate because, as shown in Chapter 5, you or a future analyst may need to “undo” your calculations later for updates or changes in assumptions. The first four sections of this chapter discuss general best practices for labeling and citing sources, and the final section provides advice for comparing estimates that were produced using different indices and assumptions.

A. Documenting assumptions

As discussed in Chapter 4, the pieces of information shown in the Documentation Checklist (reproduced here) are required for every input and output in your estimate. Chapter 7 provided recommendations for labeling these components in your spreadsheets so they will not be overly burdensome in your cost models.

<u>DOCUMENTATION CHECKLIST</u>	
☐	Value
☐	Transaction year
☐	Dollar type (TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, CP\$)
☐	Base year (if CY\$ or CP\$)
☐	Index applied (if CY\$, CP\$, or future TY\$), including publication date

You must understand these dimensions of your data in order to use them properly in an estimate; the extra effort of documenting these parameters is worthwhile, as it will facilitate reviews and future updates and ensure that you are presenting the correct results. It is especially important to document this information when you make assumptions about unknown inputs, as discussed in Chapter 4 section C, as you must understand the potential ramifications of incorrect assumptions and may want to change those assumptions later.

Another important assumption to document is the exclusion of real price change in any cost element. If you wish to assume that a commodity relevant to your estimate does not experience real price change (i.e., prices grow at the rate of inflation only), you must document and defend that decision.

B. Dollar labels on charts and tables

Dollar values in charts and tables should be labeled TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, or CP\$, and the base year specified for the latter three.

Then Year. Dollars unadjusted for relative price changes, which represent the actual amount of dollars needed at a point in time to meet an obligation or expenditure. You should specify whether TY\$ represent obligations or expenditures, though you may decide to make this information less prominent depending on the audience; for example, final cost estimate results presented in TY\$ obs may be labeled as only “TY\$” in a briefing for senior leaders, but it would be wise to include a reference to “TY\$ obs” in the speaker’s notes for those slides. If the figure makes the time-phasing of TY\$ clear, no reference to a transaction year is needed. If the time-phasing is not clear, each data point should be labeled to show its transaction year.

Constant Year. Dollars adjusted using the GDPPI, which represent the amount of dollars needed if no inflation had occurred relative to the stated base year. As described above for TY\$, you may omit the “obs” or “exp” labels on CY\$ charts for certain audiences, but may wish to include less conspicuous notes about the specific CY\$ type for future reference. Constant-Year dollars should always be labeled to show both the base year and transaction year, as discussed in Chapter 2.

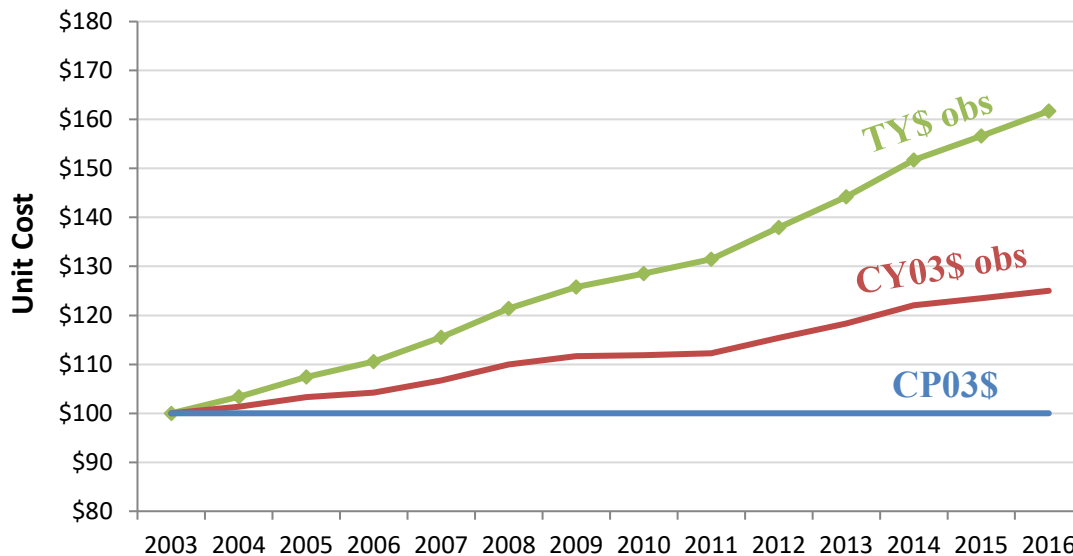
Constant Price. Dollars adjusted with a specific price index or costs modeled without the effects of escalation, which represent the amount of dollars needed for a purchase excluding the effects of inflation and some or all of real price change. Constant prices should always be labeled to show both the base year and transaction year, as discussed in Chapter 2. It is recommended that a proper index citation follows in a footnote, bibliography, speaker notes, or back-up slides. Recall from Chapters 5 and 8 that CP\$ are not generally recommended for use in external reports.

You will often encounter charts and tables with ambiguous dollar-type labels, such as fiscal year dollars, base year dollars, constant dollars, or constant budget dollars. These terms often have a base year that can indicate normalization, such as “BY17,” but it may not be clear whether an inflation or escalation index was used. “FY” dollars can, depending on the case, refer to dollars that are normalized as well as those that are not. If and when it is necessary to use an ambiguous label, annotate appropriately using the standard terminology, as presented in this handbook, to convey the precise meaning.

As discussed in Chapters 5 and 8, costs should usually be presented in only TY\$ obs or CY\$ obs. For proper interpretation, these options only require clear labeling. When you display CP\$ in a chart or table, you should include citations and interpretations for the escalation indices used, whether in a footnote, a bibliography, speaker notes, or back-

up slides. In general, CP\$ are used in the analytical process and should not be presented unless you also provide proper context. Figure 9-1 below gives an example of suggested chart labeling.

Figure 9-1. Example: Labeling TY\$ obs, CY\$ obs, and CP\$ in charts.



C. Documenting use of a published index

Published price indices are those which come from an authoritative source, whether government, industry, or academic. Some of the relevant price indices available to cost analysts are discussed in Appendix B. The best practice for documentation is to list the price indices used. The general form for citing an index is as follows:

Author/Agency, *Data Series Name* (Unique Index Description/Identifier), Publication Date, “retrieved from” Publisher Name, Web Address, “last actual” time period.

The information available for citing data series is not standard, and unique identification codes are not always provided. Even where they are, a description of the index is recommended to be provided in the title as well. The four primary attributes for describing a specific index within a data series are industry, item, geography, and

Published Index Citation Examples:

U.S. Bureau of Labor Statistics (BLS). *Employment Cost Index* (Total Compensation for U.S. Aircraft Manufacturing, ECIPCAIRNS.Q.FOS), May 2015, retrieved from IHS Global Insights, <https://www.ihs.com/products/us-economic-forecasts-and-analysis.html>, last actual Dec. 2014.

Naval Center for Cost Analysis (NCCA). *FY17 Joint Inflation Calculator* (MILPAY), Feb. 2016, retrieved from Cost Assessment Data Enterprise (CADE), <https://www.cade.osd.mil>, last actual 2015.

qualifiers. In the first example shown below, the specific price index used from the ECI had the unique ID of ECIPCAIRNS.Q.FOS. We can describe this index with our four attributes: the industry is aircraft; the item is manufacturing labor; the geography is the entire U.S.; and the qualifier is that it represents total compensation (as opposed to wages or benefits alone). Other qualifiers can include whether the index was seasonally adjusted or not, or whether the index represents the mean of the observations, or some percentile, like the 75th.

The “last actual” time period conveys the last observed date recorded in the price index. Some price indices are forecasts of the future where there is no “last actual” date. In such cases, use “forecast start” and the time period where the price index forecast starts. In other cases, the professional forecast does not extend out long enough, requiring you to perform your own forecast (see Chapter 6 section D and Chapter 7 section D for instructions). Such instances of extending professional forecasts should be documented as a separate entry that follows the Custom Index style. Where composites are used, simply list the indices used as if they had been applied independently in the form shown above, and make sure to document the relative proportions applied.

D. Documenting use of a custom index

This handbook provides numerous published escalation resources for the analyst to apply. They cover most commercial end items and supply-side inputs, such as labor and material. Yet there are often useful data not incorporated into published indices that are available to the analyst. Research into creating custom indices is encouraged where sufficient time and manpower can be applied. See Chapter 6 section D and Chapter 7 section D for instructions.

Custom indices come in several forms, but are generally either historical estimates or future extrapolations based on datasets that are either published or unpublished. For example, a time series of labor rates received directly from the contractor would be considered unpublished data, from which a custom index could be derived.

The general form for custom indices based on published sources is as follows:

“Custom Index based on published data from” Author/Agency, *Data Series Name* (Unique Data Description/Identifier), Publication Date, “retrieved from” Publisher Name, Web Address, “last actual” time period.

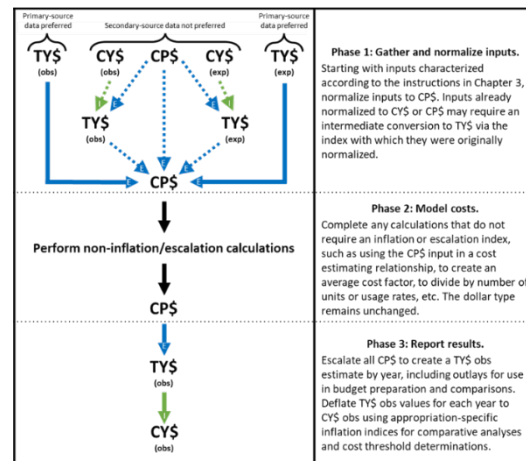
The general form for custom indices based on unpublished sources is as follows:

“Custom Index based on unpublished data from” Source/Provider, *Unique Data Description/Identifier*, “retrieved from” Source Contact/Location, “last actual” time period.

E. Estimate review and reconciliation

With the increased use of escalation indices from a variety of sources, it may become more difficult to review and reconcile estimates. As shown in Figure 5-2 (reproduced in miniature here), a typical estimate will include several layers of conversions for each input, and differences in assumptions such as the dollar type or index applied could drive deltas that compound and permeate the cost model. Consider questions like the following to identify sources of deltas:

1. Initial normalization (any dollar type to CP\$): Do you agree with the diagnosis of input dollar type, base year (if applicable), transaction year, value, and choice of any indices applied?
2. Non-inflation/escalation calculations: Do you agree with the calculations applied (e.g., CER methodologies, rates of learning)? This step will likely be the focus of estimate reconciliations.
3. Forecasting assumptions (CP\$ to TY\$ obs): Do you agree with the forecasted escalation rate and outlay profile applied to reach the TY\$ obs estimate for each cost element?
4. Inflation index selection (TY\$ obs to CY\$ obs): Do you agree with the inflation index selected, and does the outlay profile match the one reflected in the TY\$ obs estimate?



Some assumptions may be more controversial than others; for example, the last step in the list above should not generate much discussion, as only one type of index (inflation) applies. For the other steps in which analyst judgment plays a greater role, note that there are few “right” or “wrong” assumptions in selecting escalation indices—the key is to document your decisions so that you can explain them, and change them later if desired. Remember to always consult your agency best practices to promote consistency and facilitate the review process with your leadership.

When comparing your results with those of another analyst, comparisons in CP\$ may help you discover differences in programmatic assumptions and non-inflation/escalation calculations—provided you used the same escalation indices to reach CP\$. Comparisons in TY\$ obs will help you understand differences in forecasting assumptions, though they may compound with other deltas elsewhere in the estimate methodology.

10. Conclusion

This handbook provided the best practices for inflation and escalation in cost estimates. Hopefully it has helped you understand the terminology changes of the past few years, and you are well-prepared to apply these concepts in your estimates. You can always reach out to OSD CAPE with any questions.

There are several topics related to inflation and escalation that still require research, and will be reflected in later guidance. The following topics constitute the “parking lot” of items that arose during the writing of this handbook:

1. Alternative methods of calculating indices, comparing methods such as year-over-year changes (e.g., January 2019 to January 2020) vs. monthly rolling average changes, and calendar year vs. government fiscal year indices.
2. Converting monthly indices to annual indices, and vice versa.
3. List of common data sources and how to treat inputs from them.
4. Relationship of inflation and escalation indices to productivity indices.
5. Hierarchy of trusted indices: what sources are “best” for which applications?
6. Quantifying and modeling risk and uncertainty in escalation inputs.
7. More examples, including how to estimate the escalation impact of a program schedule slip.
8. Durability of economic trends, modeled via hybrid approaches to index construction (e.g., incorporating real price change in the near future and converging to inflation after some period of time) to account for expected market corrections.
9. Relationship of inflation and escalation to discounting and net present value.

Appendix A. Glossary

Definitions in this glossary may exclude advanced concepts found in other training materials, or may be tailored for relevance to inflation and escalation. Readers are encouraged to seek further information on these terms, both within this handbook and from other sources.

AVERAGE COST FACTOR. For this handbook: A value produced by dividing multiple years' worth of costs by any denominator (e.g., five years of costs divided by five years of flying hours to produce average cost per flying hour). The costs for the numerator in these factors should be normalized to CP\$ prior to calculating the factor, using a single escalation index and the same base year to normalize all cost inputs.

BASE YEAR (BY). The year against which costs are measured for comparison, as in CY\$ and CP\$, or the year of an index relative to which prices are measured, as in the base year of a general inflation index.

BASE YEAR DOLLARS (BY\$). This is an ambiguous term no longer recommended for use. Costs previously labeled "base year dollars" may refer to either CY\$ or CP\$ under the current definitions, depending on the type of index used to produce them.

COST ESTIMATING RELATIONSHIP (CER). An equation that relates costs to one or more independent variables. These equations should be produced using input data that has been normalized to CP\$, using a single escalation index and the same base year to normalize all cost inputs.

COST IMPROVEMENT CURVE (CIC). An equation that measures the relationship between costs and time-correlated learning and/or rate effects. These equations should be produced using input data that has been normalized to CP\$, using a single escalation index and the same base year to normalize all cost inputs.

COMMODITY. For this handbook: A good or service that is generally interchangeable with other goods and services of the same type. Cost estimates include multiple commodities, which may be organized by elements in a Work Breakdown Structure or Cost Estimating Structure. Commodities may be characterized at many levels of detail, from the full end item to subsystems to particular labor categories and material types.

COMPOSITE INDEX. An index that represents multiple commodities, each of which is characterized by a unique index, combined in proportions that represent a particular market basket. Composite indices may be either raw or weighted; if any portion of the composite index includes an outlay profile, the whole index should be treated as a

weighted index. Some composite indices include both inflation-only indices and indices that include real price change; if any portion of the composite index includes real price change, the whole index should be treated as an escalation index, with an inherent assumption of zero real price change on cost elements described by the inflation-only portions of the index.

CONSTANT PRICE (CP\$). A cost that has been normalized relative to a selected base year via an escalation index, or that is used as a “flat-line” modeling technique for subsequent application of escalation. Constant prices do not include the effect of escalation (i.e., neither inflation nor real price change) relative to the base year, nor do they include the effect of outlay profiles. Costs should generally be normalized to CP\$ prior to performing calculations, but costs should not generally be presented to decision makers in CP\$.

CONSTANT-YEAR DOLLARS (CY\$). A cost that has been normalized relative to a selected base year via an inflation index. Constant-year dollars exclude the effect of inflation relative to the base year, and include real price change. Also known as “real dollars” outside the DoD community. There are two types of CY\$, as determined by the TY\$ type from which they were created; removal of inflation from TY\$ obs creates CY\$ obs, and removal of inflation from TY\$ exp creates CY\$ exp. There is no outlay profile present in CY\$ exp, but CY\$ obs include the effect of the outlay profile on the real price change included. Obligations-oriented CY\$ obs, in addition to TY\$ obs, are often used in reports for customers external to the cost estimating community.

ESCALATION. The total change in price of a good or service over time, including both economy-wide inflation and commodity-specific real price change. Depending on the circumstances, escalation may be positive, negative, or zero, and may or may not be equal to inflation.

EXPENDITURES. A type of transaction that reflects an actual disbursement from the US Treasury at a particular point in time. Unlike obligations, expenditures do not include an outlay profile to account for a time delay between recording the transaction and the disbursement of funds from the Treasury.

FISCAL YEAR. For the federal government, the period of time from October 1 to September 30.

GROSS DOMESTIC PRODUCT PRICE INDEX (GDPPI). An index that measures the change in the US Gross Domestic Product over time, and that should be used for federal budgeting purposes. The index is available in multiple DoD-published documents, and originally published by the Office of Management and Budget in Historical Table 10.1, available at: <https://www.whitehouse.gov/omb/historical-tables/>

INDEX (INDICES). A table of values measuring the change in prices of a particular commodity, or “market basket” combination of commodities, relative to a stated base year. Indices may measure inflation or escalation, and may or may not be weighted via an outlay profile. Indices measuring real price change alone are not recommended for use in cost analysis.

INFLATION. The aggregate change in value of the US dollar over time, as measured by the GDPPI for federal budgeting purposes.

INPUT. Any cost value, from a primary or secondary source, obtained for use in the preparation of a cost estimate. When inputs are converted to outputs via intermediate calculations for a cost estimate, intermediate outputs may then become the inputs of further calculations before a final cost output is presented. Inputs may represent a variety of cost types, and must be characterized correctly prior to use in calculations.

LEARNING CURVE. An equation that measures the relationship between labor hours and time-correlated learning and/or rate effects. Because these equations are produced with inputs other than costs, there are no inflation- or escalation-related issues associated with their production. A learning curve would yield the same results as a Cost Improvement Curve produced with data normalized to CP\$ if and only if the index used perfectly describes (and removes) all escalation from the historical data.

MULTI-YEAR OR CROSS-YEAR INPUTS. Cost inputs that are not attributable to individual years without the use of a supplemental data source, for example total costs of a contract with a three-year period of performance. These inputs must be attributed to a single year prior to using them for inflation or escalation calculations, either by treating them as belonging to a single year (e.g., the midpoint) or using an allocation method (i.e., phasing profile) to assign portions of the total costs to single years.

NOMINAL DOLLARS. Also known as Then-Year Dollars, this term is used more frequently outside the DoD environment.

NORMALIZATION. For this handbook: The removal of inflation or escalation from a cost value to restate the value relative to a base year (i.e., the creation of CY\$ or CP\$, respectively). These calculations adjust costs to remove time-correlated distortions prior to performing other cost estimating calculations, or restate values in equivalent terms for direct comparisons.

OBLIGATIONS. A type of transaction that represents an amount of funds expected to be expended either during or after the year of obligation. Obligations have been adjusted to include an outlay profile that accounts for the anticipated change in buying power during the time that elapses between obligation and expenditure.

OUTLAY PROFILE. A set of percentages (which sum to 100%) that shows the timing pattern in which obligated funds are typically expended, or expected to be expended, for particular appropriations. For Department of Defense appropriations, the longest outlay profiles extend from the year of obligation through nine subsequent years, while the shortest represent “one-year money” that is fully expended in the year of obligation. The application of outlay profiles to raw indices produces weighted indices.

OUTPUT. The result of any calculation in a cost estimate, which may subsequently become an input of a later calculation. The desired dollar type for a given output should be selected carefully to ensure that it is appropriate for the analysis being performed.

PHASING PROFILE. For this handbook: An allocation method for reassigning multi-year or cross-year inputs to individual years for use in inflation or escalation calculations. For example, a potential phasing profile for a three-year contract amount may be the labor hours per year or relative value of material invoices per year, either of which may be an appropriate proxy for understanding the timing of costs by year.

PRIMARY VS. SECONDARY SOURCES. For this handbook: Primary sources represent unmanipulated data, such as obligations or expenditures as they were recorded at the time of the transaction; secondary sources represent pre-normalized data, such as inflation-adjusted (CY\$) or escalation-adjusted (CP\$) costs from an automated database. Cost analysts should use data from primary sources whenever possible in order to avoid the uncertainty that may arise when using data that was previously normalized by an incorrect index, or by an index that is not appropriate in the context of a particular calculation.

RAW INDEX. An index that does not include the effect of an outlay profile.

REAL DOLLARS. Also known as Constant-Year Dollars, this term is used more frequently outside the DoD environment.

REAL PRICE CHANGE (RPC). The rate of change in prices for a specific commodity, or market basket of different commodities, excluding economy-wide inflation. This handbook recommends breaking down real price change into the effects of quantity changes, quality changes, and pricing changes for cost estimating purposes.

THEN-YEAR DOLLARS (TY\$). Costs that reflect the value of money at the time of a transaction. The type of transaction defines the two types of TY\$: obligations (which include outlay profiles) and expenditures (which do not include outlay profiles). Also known as “nominal dollars” outside the DoD environment.

TRANSACTION YEAR. The point in time at which an obligation is obligated or an expenditure is expended. Most commonly modeled as “Fiscal Year” columns in a phased cost estimate.

WEIGHTED INDEX. An index that includes the effect of an outlay profile.

Appendix B. Resources

A. Service-level indices

Since some of the OUSD(C) guidance is inflation and some escalation, the published Service-level indices will also contain inflation and escalation. It is important for analysts to read notes and instructions accompanying an index to ensure correct usage.

1. Air Force indices

Starting in FY16, the raw Air Force Indices separate price escalation indices from inflation indices and provide them proper labeling. There are six price escalation indices: fuel; general schedule and wage board pay; and four related to military compensation. The raw inflation index is repeated for various appropriations. Figure B-1 below shows an excerpt from the Air Force raw index tables with escalation indices (labeled “SPECIFIC PRICE INDICES”) highlighted in blue.

Figure B-1. Excerpt from Air Force raw indices.

USAF Raw Inflation Indices Based on OSD Raw Inflation Rates Base Year (FY) 2016											
Fiscal Year	SPECIFIC PRICE INDICES						INFLATION INDEX				
	Military Compensation				General Services & Wage Board Pay (3400)	Fuel	Operations & Maint. Non-Pay, Non-POL (3400)	Research, Develop., Testing, Evaluation (3600)	Military Construct. (3300)	Aircraft, Space & Missile Procurement (3010/20/21)	Ammo & Other Procurement (3011/3080)
	Pay Base (3500)	Other Expenses (3500)	Total (3500)	Retirement (3500)							
2012	0.951	0.959	0.952	1.039	0.971	1.089	0.949	0.949	0.949	0.949	0.949
2013	0.967	0.972	0.967	0.988	0.971	1.181	0.963	0.963	0.963	0.963	0.963
2014	0.978	0.981	0.978	1.009	0.978	1.146	0.977	0.977	0.977	0.977	0.977
2015	0.988	0.989	0.988	1.013	0.988	1.079	0.988	0.988	0.988	0.988	0.988
2016	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2017	1.015	1.014	1.015	1.015	1.015	0.918	1.018	1.018	1.018	1.018	1.018
2018	1.031	1.027	1.031	1.032	1.031	0.962	1.036	1.036	1.036	1.036	1.036
2019	1.048	1.041	1.047	1.048	1.048	0.995	1.057	1.057	1.057	1.057	1.057
2020	1.066	1.057	1.066	1.066	1.066	1.021	1.078	1.078	1.078	1.078	1.078

The Air Force escalation indices do not have multi-year outlay profiles associated with them; i.e., the funds for pay and fuel are generally expended in the year of the appropriation. Therefore, normalization of pay and fuel dollars can be performed using the raw index and no weighted variants are available. It is important to note that all of the weighted indices the Air Force publishes are inflation indices. The weighted indices differ only by the OUSD(C) outlay profiles imparted onto them. See Chapter 7 section E for further information about calculating weighted indices.

One unique aspect of the Air Force weighted indices is that some of the indices are labeled “Special” while others are labeled “Other.” The “Special” indices are intended to be used for classified programs within that appropriation. For example, an analyst

wanting to normalize a classified aircraft program for inflation would select the index with the heading “Aircraft Procurement Special (3010).” Conversely, to normalize an unclassified Aircraft program for inflation, the analyst would utilize the index with the heading “Aircraft Procurement Other (3010).”

The Air Force Indices are hosted under Inflation on the TOOLS page of the Cost Assessment Data Enterprise (CADE), <http://cade.osd.mil/>.

2. Army/Navy Joint Inflation Calculator (JIC)

Each year, the Army and Department of the Navy publish the Joint Inflation Calculator (JIC) which provides raw and weighted indices for specific categories and base years. Like the Air Force Indices, the JIC contains both inflation and escalation indices. As of the FY16 JIC, 14 of the Navy’s 35 indices reflect some degree of real price change. Of the Army’s 26 indices, six are escalation indices. The JIC also includes eight defense-wide indices, none of which reflect escalation (i.e., all are based on the GDPPi).

In general, escalation-related indices in the JIC come in three types:

- 1) Pay (denoted by “Pay”) and Fuel (denoted by “Fuel” or “_F”)
- 2) Composite (denoted by “COMP”)
- 3) BLS History (denoted by “BLS HIST”)

Figure B-2 below shows an excerpt of Navy indices from the JIC with escalation indices highlighted in blue. All other indices are based on inflation only.

Figure B-2. Excerpt of Navy weighted indices from the JIC.

This sheet displays the user selected index, Weighted or Budget Year, for all appropriations Note * indicates OSD cost element (OSD Fuel may differ significantly from FMB Fuel rates in the Budget Window)																				
Enter Base Year (1970-2024) →				2016	Select →				Weighted Index											
	APN	BRAC	BRAC ER	Civ Pay*	ENV REST	FH (Con) Purch	FH (Ops) Purch	FH Con COMP	Fuel*	Mil Pay*	Milcon COMP	Milcon DoD	Milcon Purch	Milcon Res Purch	MPMC COMP	MPMC Non-pay	MPN COMP	MPN Non-pay	NDSF (BLS HIST)	
2007	0.8921	0.8823	0.8884	0.8803	0.8884	0.9013	0.8756	0.8762	0.6724	0.8288	0.8827	0.8953	0.8922	0.8936	0.8291	0.8690	0.8284	0.8677	0.8840	0.8070
2008	0.9055	0.8986	0.9025	0.9083	0.9025	0.9150	0.8936	0.8956	0.9085	0.8552	0.8991	0.9095	0.9074	0.9073	0.8551	0.8891	0.8545	0.8881	0.9012	0.8394
2009	0.9181	0.9095	0.9090	0.9429	0.9090	0.9294	0.9060	0.9110	0.6250	0.8877	0.9154	0.9272	0.9198	0.9199	0.8866	0.9021	0.8863	0.9013	0.9136	0.8652
2010	0.9375	0.9225	0.9221	0.9661	0.9221	0.9444	0.9166	0.9234	0.7831	0.9190	0.9430	0.9472	0.9430	0.9438	0.9167	0.9111	0.9165	0.9099	0.9246	0.8908
2011	0.9567	0.9453	0.9389	0.9708	0.9389	0.9680	0.9342	0.9392	0.9727	0.9363	0.9651	0.9668	0.9651	0.9650	0.9347	0.9283	0.9346	0.9284	0.9463	0.9265
2012	0.9711	0.9605	0.9541	0.9708	0.9541	0.9833	0.9501	0.9529	1.0028	0.9508	0.9801	0.9813	0.9801	0.9801	0.9495	0.9445	0.9497	0.9455	0.9619	0.9504
2013	0.9823	0.9751	0.9683	0.9708	0.9683	0.9989	0.9656	0.9663	1.0871	0.9668	0.9954	0.9969	0.9954	0.9889	0.9651	0.9589	0.9650	0.9588	0.9767	0.9721
2014	0.9977	0.9899	0.9827	0.9781	0.9827	1.0158	0.9800	0.9798	1.0555	0.9781	1.0119	1.0135	1.0119	1.0047	0.9771	0.9732	0.9770	0.9731	0.9920	0.9920
2015	1.0147	1.0058	0.9981	0.9879	0.9981	1.0342	0.9949	0.9939	1.0787	0.9879	1.0300	1.0317	1.0300	1.0224	0.9877	0.9871	0.9877	0.9871	1.0080	1.0080
2016	1.0333	1.0237	1.0155	1.0000	1.0155	1.0540	1.0119	1.0102	1.0000	1.0000	1.0497	1.0513	1.0497	1.0417	1.0007	1.0033	1.0007	1.0032	1.0258	1.0258
2017	1.0533	1.0431	1.0345	1.0130	1.0345	1.0748	1.0307	1.0282	0.9830	1.0130	1.0703	1.0720	1.0703	1.0621	1.0148	1.0215	1.0149	1.0214	1.0453	1.0453
2018	1.0742	1.0636	1.0548	1.0277	1.0548	1.0962	1.0507	1.0475	0.9918	1.0277	1.0917	1.0934	1.0917	1.0833	1.0305	1.0411	1.0307	1.0410	1.0657	1.0657
2019	1.0957	1.0849	1.0759	1.0431	1.0759	1.1181	1.0717	1.0677	1.0008	1.0431	1.1135	1.1152	1.1135	1.1050	1.0472	1.0620	1.0474	1.0618	1.0870	1.0870
2020	1.1176	1.1066	1.0974	1.0611	1.0974	1.1405	1.0931	1.0886	1.0098	1.0611	1.1358	1.1376	1.1358	1.1271	1.0661	1.0832	1.0661	1.0830	1.1088	1.1088
2021	1.1400	1.1287	1.1194	1.0802	1.1194	1.1633	1.1150	1.1101	1.0189	1.0802	1.1585	1.1603	1.1585	1.1496	1.0858	1.1049	1.0858	1.1047	1.1310	1.1310
2022	1.1628	1.1513	1.1418	1.0997	1.1418	1.1866	1.1373	1.1320	1.0280	1.0997	1.1817	1.1835	1.1817	1.1726	1.1058	1.1270	1.1059	1.1268	1.1536	1.1536
2023	1.1860	1.1743	1.1646	1.1194	1.1646	1.2103	1.1600	1.1543	1.0373	1.1194	1.2053	1.2072	1.2053	1.1961	1.1263	1.1495	1.1263	1.1493	1.1767	1.1767
2024	1.2098	1.1978	1.1879	1.1396	1.1879	1.2345	1.1832	1.1771	1.0466	1.1396	1.2294	1.2313	1.2294	1.2200	1.1471	1.1725	1.1471	1.1723	1.2002	1.2002

The pay and fuel escalation indices are provided directly from OUSD(C) guidance, and include no outlay profile, meaning the weighted indices shown are equivalent to raw indices (hence the value of 1.0000 in the base year of 2016). The composite indices blend an inflation index with an escalation index, such as fuel and/or

pay. For example, the Family Housing Construction Composite index blends “FH Con Purchases,” an index fully based on inflation, with the Civ Pay index to produce the “FH Con COMP,” index. The last type of escalation-related index found in the JIC is calculated from NAVSEA/Bureau of Labor Statistics (BLS) estimates. These are called “BLS History” (denoted with “BLS HIST” in the JIC) because NAVSEA funds the BLS effort to calculate the past escalation rates for some military purchases. The forecast rates for BLS HIST, however, are inflation and should not be used as a basis of escalation. Note that the last BLS History actual would be two years prior to the President’s Budget (PB) for which the JIC was released (e.g., in the FY17 JIC, the last BLS History actual would be in FY15).

There are two Navy indices which have NAVSEA/BLS history and inflation forecasts, the National Defense Sealift Fund “NDSF (BLS HIST)” and Shipbuilding and Conversion, Navy “SCN (BLS HIST).” These indices are provided to give the analyst the option of using an index more closely aligned with actual industry price experience rather than adjusting solely for inflation.

The JIC is designated by PB year, so that the annual release in February 2016 was designated FY17, and was to be used for the FY17 President’s Budget (PB). It is released by the Naval Center for Cost Analysis (NCCA) and hosted under Inflation on the TOOLS page of the Cost Assessment Data Enterprise (CADE), <http://cade.osd.mil/>. Additional documentation is available on the NCCA website, <https://ncca.navy.mil/>.

3. Additional government-provided sources

The DoD and other government agencies develop specialized price indices which often go unpublished in public sources. For example, NAVSEA also produces a forecast for the ship escalation index (SCN, BLS HIST), but it remains unavailable through the JIC. NAVAIR, the air systems counterpart to NAVSEA, produces its own aircraft escalation index which is not publicly available. Various other DoD and non-DoD cost departments have commissioned studies to develop price indices for military systems and resources, such as the satellite price index from the National Reconnaissance Office (NRO). Contact your leadership for insight and access to some of these escalation resources.

B. Price indices and quality

Price indices are typically calculated by comparing the price of the same item or group of items across multiple time periods. These indices answer the question, “how much more money would you need today to buy the same basket of items that you bought yesterday (last month, last year, etc.)?” A price index captures the net effect of all market forces affecting supply and demand that go into determining price.

Cost analysts should be aware of whether any particular price index they are considering using is adjusted for quality. While a price index measures the change in price of the same item over different time periods, sometimes the item itself is not exactly the same as it was in the earlier time period due to improvements in that item's quality. For example, a price index for computers could compare the price of a computer today with the price of a computer five years ago, yet a computer available for purchase today would be of much greater capability than one available for purchase five years ago. That makes it difficult to interpret the price change in computers over time. A quality-adjusted price index will remove the effect of quality changes on price. Assuming quality generally increases over time, adjusting a price index for quality will lower the rate of growth in the price index because the index removes the portion of price increases associated with quality.

C. Producer Price Indices

A Producer Price Index (PPI) measures changes in prices received by producers for their output (net of taxes). The Bureau of Labor Statistics (BLS) measures separate PPI's for separate industries and items. This makes each PPI a "representative" price escalation index, rather than an inflation index. The BLS tracks more than 4,100 PPI's on a monthly basis: more than 3,700 for goods and more than 400 for services. There are also PPIs available at different levels of aggregation. For example, while there is an aggregate PPI for "mining," there are also separate PPIs for specific industries within mining, such as "coal mining," "iron ore mining," "gold ore mining," and so on. This level of granularity makes PPIs a good potential source for cost estimators to find an appropriate price escalation rate. Industry-level PPIs are a weighted average of all PPIs within that industry where the weights are fixed to a base period for relatively long periods of time.

The BLS adjusts PPIs for quality and product changes that impact the costs of production, so that only prices for items of comparable attributes and qualities are measured. It does not, however, adjust for small quality and product changes that do not change the costs of production. The price effects of learning and bulk buys (and other incentive and rebate programs offered by the seller) *are* reflected in a PPI. For example,

Hedonic Modeling of Price Indices

One method for determining a quality-adjusted escalation index is to use a parametric, or "hedonic," model. The model simultaneously estimates quality and escalation by attempting to explain an item's TY cost using a set of independent variables.

A variable subset explains price variation due to quality differences between items. The remaining variables are binary, or dummy, variables that represent the time-period of the observed TY cost. With quality held constant, the coefficients on the dummy time variables form the escalation index. Some hedonic models use additional variables to hold constant demand effects (such as learning and rate).

The BLS occasionally uses hedonic models to estimate price indices, such as for the laptop computer PPI.

if a manufacturer charges \$100 per unit for 1 unit and \$90 per unit for two units, the PPI would reflect the weighted average price between \$90 and \$100 (depending on the number of units sold to each customer).

Analysts are encouraged to gain a basic understanding of the PPI methodology. The BLS Handbook on Methods contains a detailed chapter on the PPI. The chapter may be downloaded from the BLS PPI methods website: <http://bls.gov/ppi/methodology.htm>. The website also contains a description of how particular indices are calculated.

D. Bureau of Economic Analysis (BEA) deflators

The Bureau of Economic Analysis (BEA), which develops the GDPPI, also publishes deflators for the procurement of five military systems: aircraft, missiles, ships, vehicles, and electronics. These “representative” escalation indices are quality-adjusted by attributing all production costs associated with a specification change to a change in quality.³⁹ The approach, also occasionally used by the BLS PPI, does not measure quality by functional usefulness, but by cost of producing the new specification. Therefore, if a good inherits a new specification that costs the producer an additional dollar per item and increases the price by a dollar, no price change is observed for the quality-adjusted good. Unlike the PPI, however, the BEA deflators do not use fixed weights to control for industry composition. The index is continually reweighted to reflect the industry composition current to the observation.

BEA Deflators

The BEA deflators tend to show significantly less price growth for their respective items than BLS PPI equivalents. Reasons for the differences include:

- Military vs. civilian markets
- Quality-adjusted at the component level
- Controls for learning and rate
- Weighting methodology

For military goods, the BEA considers the value of quality changes by component. For example, aircrafts are broken down into component groups such as airframe, electronics, and engine. When comparing the quality differences between components of different aircraft, the BEA only considers prices after the 100th unit of production for a new aircraft design. The intent is to remove the effects of learning, wherein workers gain efficiencies and drive down unit costs in new production starts.

E. Public labor cost data

The BLS produces three primary surveys, described in the following subsections, from which they develop figures on the cost of employment by occupation. They include

³⁹ Galbraith, K.D. and Ziemar, R.C. “Deflation of Defense Purchases” in *The U.S. National Income and Product Accounts: Selected Topics*. Ed. Foss, Murray, University of Chicago Press, 1982, pg. 152.

over 800 occupations from 375 metropolitan and 170 nonmetropolitan areas for about 400 industries, using the same industry classifications as the PPIs.⁴⁰ Unlike the PPIs, however, the statistics from the BLS employment surveys are not quality-adjusted. The BLS reports observed labor costs, so the cost analyst must be aware that normalizing with indices derived from these data removes more price change than if quality, or labor productivity, were controlled for.

1. National Compensation Survey

The quarterly National Compensation Survey (NCS) measures changes in the cost of labor to employers. The total compensation costs are broken down into wages and benefits, the latter including additional breakouts like paid leave, overtime, insurance, retirement, and Social Security. The occupational categories captured in the National Compensation Survey tend to be quite broad, such as “professional, specialty, and technical” or “manufacturing.” Industry attributes allow for more detailed targeting, such as “aircraft manufacturing.” The results from the survey are the basis for two key price series, the Employer Cost for Employee Compensation (ECEC) and the Employment Cost Index (ECI).

The ECEC data provides the cost per hour of employment by attributes described above. For example, the average hourly compensation for U.S. aircraft manufacturing in the quarter ending December 2015 is \$68.64, of which \$41.84 is wages, \$6.13 is paid leave, \$7.11 is insurance, etc. With a time series of compensation data from the ECEC, the analyst can derive a labor cost index.

The ECI are “representative” escalation indices that use the same data as the ECEC, though ECIs are not provided for component cost elements of benefits. The analyst can only get an ECI for total compensation, wages, and total benefits. The other important difference between the ECEC and the ECI is how the industry and occupation categories are weighted. “The ECI is designed to measure how compensation paid by employers would have changed over time if the industry/occupation composition of employment had not changed from a base period, while the ECEC is designed to measure the current cost for employee compensation.”⁴¹ The BLS recommends that the ECI be used for examining changes in compensation over time, while the ECEC be used to obtain the average compensation level at a point in time.⁴²

⁴⁰ Bureau of Labor Statistics (BLS), <http://www.bls.gov/bls/blswage.htm>. Note that the forecasts under discussion generally include some number of years of historical values and that those historical values are often retroactively revised as much as a couple years later.

⁴¹ Lettau, M.K., Loewenstein, M.A., and Cushner, A.T. “Explaining the Differential Growth Rates of the ECI and ECEC.” *Compensation and Working Conditions*. 1997.

⁴² Ibid.

2. Occupational Employment Statistics Survey

Data from the Occupational Employment Statistics (OES) is published from another survey that provides more detailed occupational, industry, and geographic categories than the NCS. For example, there are dozens of types of engineers captured, including aerospace, civil, computer hardware, electrical, mechanical, nuclear, and ship. These can be further broken out by detailed industry and metropolitan areas. For example, ship engineers' mean hourly wage fell 2.6% in Virginia Beach-Norfolk-Newport News area between May 2013 and May 2014.

The OES only provides wages and total employment with no insight into the cost of benefits. It does, however, report the mean and median wages, along with various percentiles. The analyst can then get an idea of the range and distribution of wages for that occupation, industry, and geographic location.

3. Current Population Survey

The Current Population Survey (CPS) is different from the NCS and OES in that it surveys worker's earnings and not employer's labor costs. The utility of these data are that in addition to earnings by occupation type, they provide demographic information such as age, sex, race, and education. Data from the former two surveys, however, are recommended because they tend to have more detailed occupational categories and are based on labor cost to the firm.

F. Contractor Forward Pricing Rate (FPR) data

The Administrative Contracting Officer (ACO), either from Defense Contract Management Agency (DCMA) or the Supervisor of Shipbuilding, negotiates labor rates by occupational category for defense contractor business units. It also negotiates indirect rates, which include both overhead (e.g., training and employee benefits) and general and administrative (e.g., facilities, equipment, corporate costs). The fully burdened labor rate includes the cost of a worker's wages (direct labor rate) as well as indirect costs (wrap rate). The direct and indirect rates, which typically include forecasts for five or more years, are called Forward Pricing Rates (FPRs) and are negotiated with DCMA annually.

The FPRs represent the most appropriate price data available for DoD purchases relative to a contractor's value-add. Indices derived from the FPRs can be considered an "own" escalation index with respect to normalizing labor costs (see Chapter 7). While price indices from the PPI and ECI represent specific market prices, the FPRs include yet more specific information regarding the contractor business effects on escalation. It is recommended that DoD cost analysts seek time series of FPRs to normalize historical or project future prices when possible, especially where the performing contractor business unit is known. However, defense contractors often change their accounting and operations such that a consistent time series of FPRs is difficult to develop. Because these

data are sensitive, DCMA houses the FPR information in the gated Contracts Business Analysis Repository⁴³ system whose access is generally restricted to government personnel on a need-to-know basis.

G. Forecasting resources

The BLS and BEA, considered the authoritative sources for the various escalation rates and inflation rates that they produce, only produce values for historical actuals. When cost analysis requires the use of a price forecast, such as forecasting future costs of a weapon system, analysts do have some sources, both public and private, that they can access to obtain these forecasts.

Examples of public sources for escalation and inflation forecasts include the Congressional Budget Office (CBO), the Office of Management and Budget (OMB), and the Energy Information Administration (EIA). CBO and OMB typically produce forecasts of general inflation, such the GDPPI or the consumer price index, and escalation rates aggregated at a high level, such as the total compensation ECI. Analysts will likely not find forecasts of specific PPIs or ECIs from these agencies. EIA annually produces forecasts of energy and fuel prices, at a relatively detailed level.

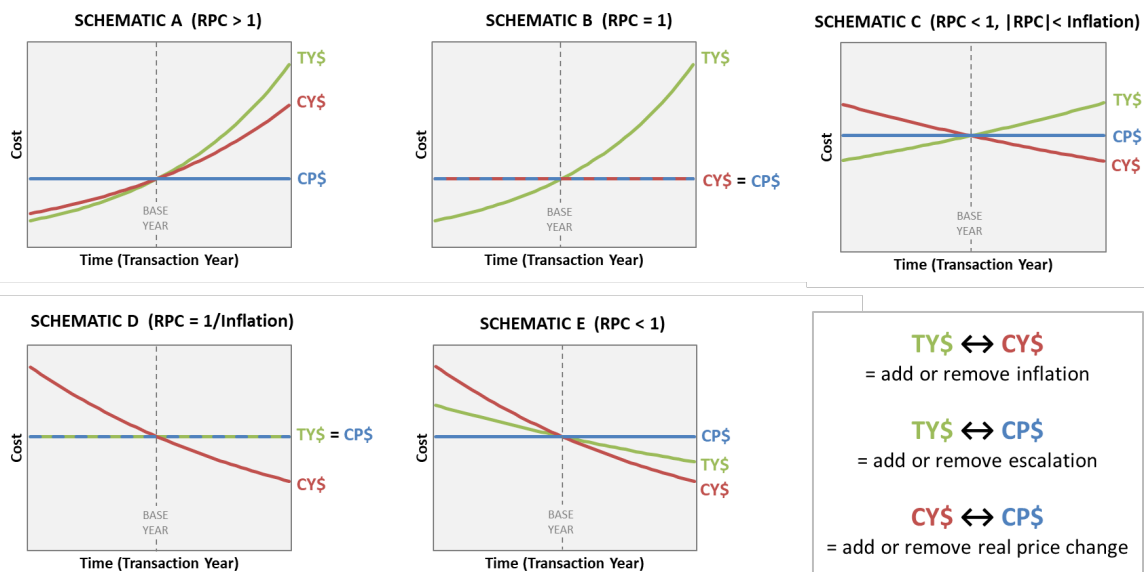
There are several private sources of price and inflation forecasts. One private source commonly used in the Department of Defense is IHS Global Insight (IHS). IHS maintains an extensive macroeconomic model that is used to generate forecasts of almost any economic indicator or price index produced by BLS and BEA. Forecasts from IHS are generally available going out 30 years. IHS is commonly used by cost analysts in DoD to obtain a forecast of a specific PPI needed in their analysis (e.g., the PPI for titanium). DoD maintains multiple subscriptions to IHS forecast data, and cost analysts should check with their respective Service cost agency to determine their access.

⁴³ Contract Business Analysis Repository (CBAR). Hosted by the Defense Contract Management Agency. See <http://www.dcmamail.com/DCMAIT/cbt/CBAR/index.cfm>.

Appendix C. Advanced Terminology

Escalation may be positive, zero, or negative; assuming positive inflation (as is typical for the U.S. economy), the rate of real price change determines the appearance of escalation (see Figure C-1). If real price change is positive ($RPC > 1$; Schematic A), zero ($RPC = 1$, or the market basket mirrors the entire economy; Schematic B), or negative but smaller in magnitude than inflation ($RPC < 1$, $|RPC| < \text{inflation}$; Schematic C), escalation will be positive. If real price change is the inverse of inflation ($RPC = 1/\text{inflation}$; Schematic D), escalation will be zero. If real price change is negative ($RPC < 1$; Schematic E), escalation will be negative. The fact that some of these schematics show lines for CY\$ with a downward slope may be surprising to some readers, given that they visualize inflation as a positive force; recall that costs normalized to CY\$ are not showing the rate of inflation itself, they are showing the costs when inflation is removed. Therefore, you will always be *removing* a positive value (unless the U.S. economy experiences deflation, or $\text{Inflation} < 1$), not necessarily *obtaining* a positive value as a result; for this reason, the CY\$ line is always below the TY\$ line but may not have a positive slope.

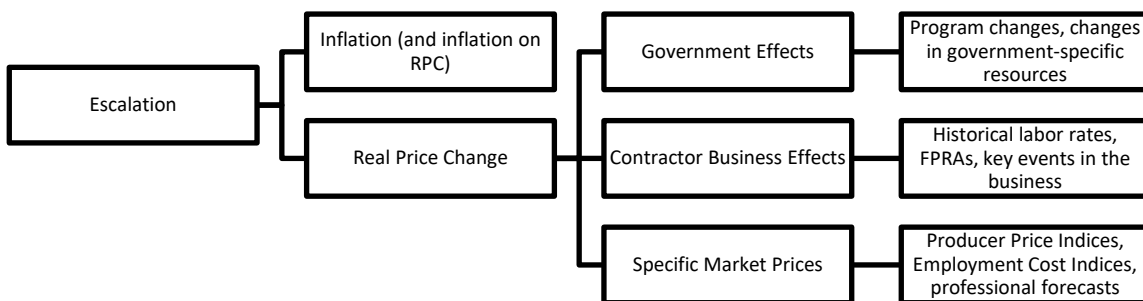
Figure C-1. Dollar type relationships depend on magnitude and sign of RPC.



Appendix D. Advanced Framework Concepts

Figure D-1 illustrates a basic framework for considering the components of escalation from an economist's perspective. This framework organizes real price change drivers based on whether they are government-driven, contractor-driven, or related to the broader market of the product or service in question.

Figure D-1. Economist's framework for analyzing escalation.



A. Specific market price effects

While inflation measures the aggregate change in prices for the overall US economy, an individual item sits within an industry or commodity market which may experience average price changes different from the rate of inflation. Professionally developed price indices are available to track the price changes in many specific markets. For example, if the item of analysis were a missile seeker, you could use the Producer Price Index (PPI) for Search Detection Navigation and Guidance; or if it were a ship, the PPI for Shipbuilding Construction. Refer to Appendix B for a discussion of escalation index resources. Normalizing observed prices using a specific market price index simultaneously removes both general inflation and the real price change related to the specific market. Conversely, applying a specific market price index to a value applies both inflation and real price change. Therefore, you should not consecutively apply an inflation index and a specific market price index to normalize or forecast because doing so would account for inflation twice.

B. Contractor business effects

In addition to the subject of an estimate being associated with a broader industry or commodity group, the particular company or companies that produce items for the estimated program may experience real price change at a different rate than the industry

average. You should consider actions a contractor takes, or is expected to take, that affect program cost; for example, a particular company may:

- sell off excess facilities to lower operating costs;
- increase retirement benefits in response to a new pension regulation or competition for qualified labor;
- change its business base (e.g., add or subtract contracts from its overhead pool);
- relocate to a new geographic location;
- reorganize its business units;
- increase or decrease salaries in response to changes in workforce demographics, skill mix, or union agreements; or,
- implement process improvements.

These and other considerations are especially important for firms that have significant pricing power in their industry. You should explore changes that have affected historical costs for the companies represented in your estimate, and the extent to which those factors (and any new ones) will drive costs in the future.

The contractor business effects listed above could affect the contractor's labor rates, or price paid by the government per hour of labor. The fully burdened labor rate includes much of an individual contractor's experience of price escalation, including capital, administrative, and fringe costs. However, external forces other than contractor business effects can also affect labor rates and escalation—goods and services purchased by the contractor are also subject to inflation, specific market prices, the business effects of subcontractors, and government decisions.

Like specific market price indices, indices for contractor labor rates typically include both inflation and real price change. De-escalating observed prices with contractor labor rates removes the effects of inflation as well as elements of specific market price changes, so be careful not to double-count inflation or real price change depending on how you apply any other indices in your estimate.

C. Government effects

The government purchaser controls demand for DoD end items, creating substantial effects on the year-to-year price variation. For example, increasing annual production may induce learning and rate effects which will put downward pressure on the unit cost of an item. The government also negotiates non-quality requirements with the contractors, such as information reporting and other regulations, which affect the price paid. Some other examples of government effects on escalation include:

- Government Furnished Equipment (GFE) and Material (GFM), which become inputs into the contractor's production process, but the contractor does not necessarily determine their sourcing or pricing
- Changes in the government's acquisition policies
- Changes to Working Capital Fund rates
- Pay raises for military service members and government civilians
- Comptroller-dictated fuel prices

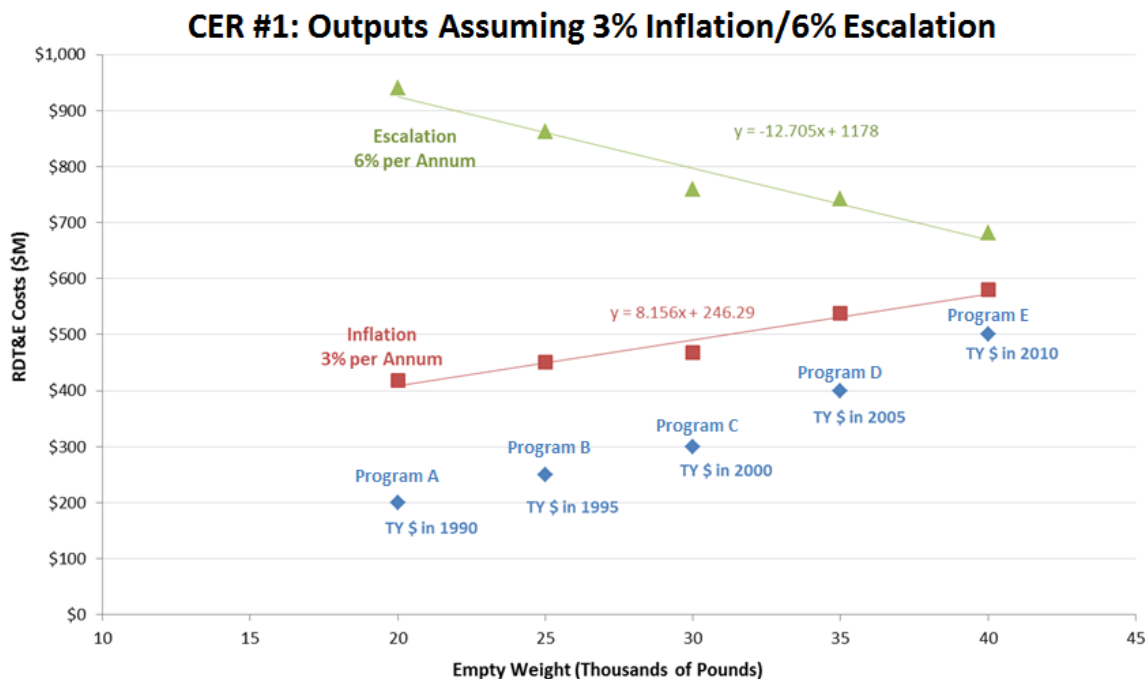
As with the other real price change categories in this framework, some of these considerations may also be attributed to other categories depending on the commodity and structure of the estimate; be careful not to double-count or omit drivers of real price change.

Appendix E. Advanced Output Concepts

A. Intermediate escalation application in CER development

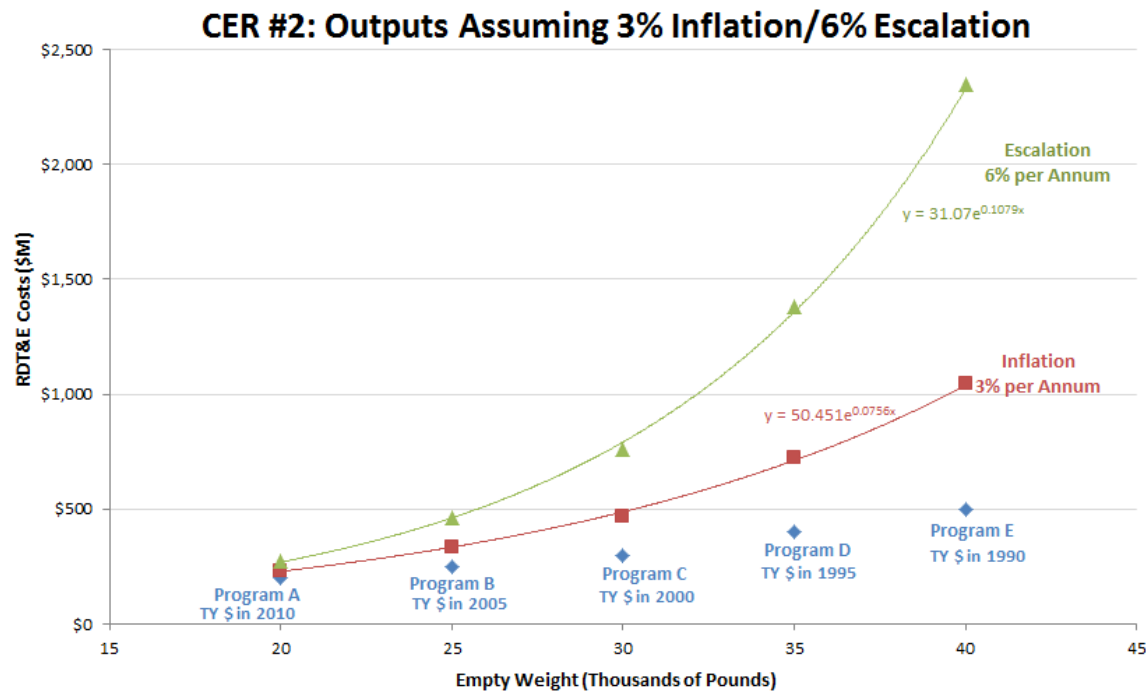
The CER example provided in Chapter 5 section B showed the effect of index selection on the slope of the equation; this appendix will show the same effect when the technical characteristic of interest is also correlated with time. For example, say you want to create a CER that correlates aircraft empty weight with RDT&E costs using data from completed contracts. Data for five analogous programs show that there has been a steady increase in empty aircraft weight over time, with the lightest aircraft developed in 1990 and the heaviest developed in 2010. Figure E-1 below shows the results of building a CER using these data normalized to CY\$ (using a notional inflation index of 3 percent per year) compared to the same data normalized to CP\$ (using a notional escalation index of 6 percent per year). The same phenomenon could be observed when comparing CERs built using alternative escalation indices (i.e., CP\$ normalized to remove escalation of different magnitude).

Figure E-1. CER development when technical characteristic directly correlated with time.



In the above example, the choice of index not only changes the slope, but can also change your qualitative understanding of the relationship: whether cost and the technical characteristic are positively or negatively correlated. Similarly, as shown in Figure E-2 below, the reverse relationship between weight and time makes the relationship appear exponential rather than linear.

Figure E-2. CER development when technical characteristic indirectly correlated with time.



The fact that the index selected affects the coefficients of a CER equation may make the relationships or index selection seem arbitrary, but that is not the case and should not deter you from applying program-specific escalation indices. You can use any equation to get results, and as long as you use a CER that was built in a manner relevant for your estimate—and use the equation in a manner consistent with how it was built—you should obtain a valid result. This also means that when you use a CER that used a particular escalation index to generate its CP\$ inputs, you must use the same escalation index to convert the CER output for your program (which will be in CP\$ initially) to TY\$ for your final cost estimate.

B. Advanced escalation application in CER development

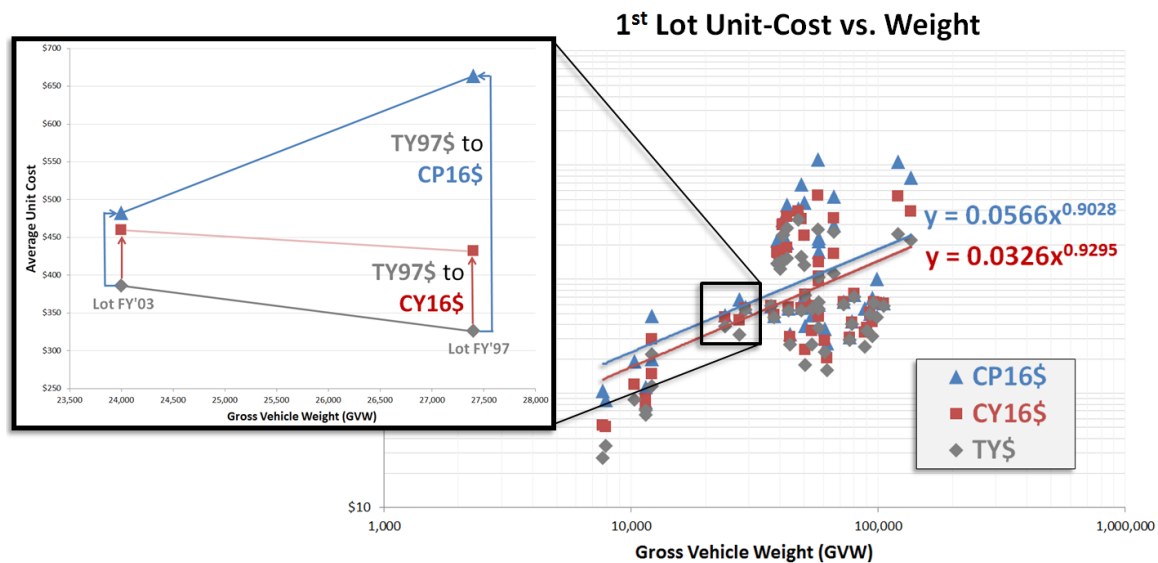
The following section will expand on the basic example from Chapter 5 section B and provide additional information for handling escalation in CER development. Assume that a new ground vehicle has just finished its Engineering and Manufacturing Development (EMD) phase and is authorized to move into its first production lot. The prototype units have a known cost, and the contractor used an engineering build-up method as the basis for their proposal. Your task is to derive an independent cost estimate using a set of historical data on first production lots. For each analogy, the data provided include: year of first lot purchase, total cost, quantity, and five technical characteristics.

The historical production data span nearly 20 years, implying large distortion to the purchasing power of the dollar between programs. In order to explore cost relationships, you must first normalize the data. Per the instructions in Chapter 5 section B, you first normalize the TY\$ inputs to CP\$ using an appropriate escalation index that is weighted by the outlay profile for the appropriation Weapons & Tracked Combat Vehicles Procurement, Army (WTCV). For comparative purposes, you also normalize the TY\$ using an inflation index to return CY\$ inputs for the CER, although developing CERs using CY\$ is not considered a best practice (as described in Chapter 5).

You decide to create a bivariate CER that correlates the log of first lot unit cost (in both CY\$ and CP\$) and the log of gross vehicle weight; you put the variables into log space because you expected that a percentage change, as opposed to unit change, in weight would leave to a percentage change in unit cost. If tactical vehicle prices have experienced real price change, these two CER models will differ when estimated in CY\$ and CP\$. This difference is shown in Figure E-3 below. While the unit costs are higher in CP\$ than in CY\$, the general relationship between cost and weight is maintained: an increase of 1.00% in weight is associated with a 0.90% increase in CP16\$, and a 0.93% increase in CY16\$ (see exponents of CER equations in Figure E-3).

The correlation between unit cost and cost driver is not always consistent between CY\$ and CP\$. In the left-hand chart of Figure E-3, the choice of normalization can result in substantially different views of the prevailing relationship across data subsets. Where the independent variable (weight) has a strong correlation with time, an escalation rate significantly different than inflation can result in estimated relationships of opposite signs (as discussed in the previous section). In such cases, a CY\$ CER mistakenly attributes cost variation to the independent variable that which results from real price change (i.e., omitted variable bias). Because there is little correlation between weight and time for the dataset as a whole, the line of best fit has a similar slope for both CY\$ and CP\$ normalizations. The neglect of real price change is largely absorbed by the intercept term.

Figure E-3. Bivariate Cost Estimating Relationship.



You decide to improve upon your bivariate CERs above by including a number of other important cost drivers which can pick up variation not explained by vehicle weight. For example, a light vehicle may cost more than a heavy vehicle if it had other quality differences, such as a higher maximum speed. Adding other variables as regressors into the parametric analysis allows for such considerations. Figure E-4 below shows the output from a multiple regression on six independent variables. Note how the regression coefficients on weight have changed significantly from the bivariate specification as cost variation was better attributed the other variables. An increase of 1.00% in weight is associated with a unit cost increase of 0.28% in CP16\$ and 0.42% in CY16\$. The inclusion of other variables, such as “derivative,” affects these changes: vehicles which are derivatives (i.e., not a new design), are associated with CP16\$ unit costs ($e^{-0.25} = 0.775$) 77.5% that of new vehicles, all else equal. In CY16\$, derivatives are associated with reduced savings as derivative unit costs are only ($e^{-0.14} = 0.870$) 87.0% that of new vehicles. Also note that the derivative variable is not statistically significant at the 90% level in the CY\$ formulation.

Figure E-4. Multivariate regression coefficients (standard errors) in log-space.

		LN(Constant-Price 16\$)	LN(Constant-Year 16\$)	LN(Then-Year)	
Technical Characteristics	LN[GVW (lbs)]	0.28 (0.09)***	0.42 (0.09)***	0.54 (0.1)***	
	LN(Max speed)	-2.35 (0.28)***	-1.45 (0.29)***	-0.78 (0.32)**	
	Combat (Dummy)	1.28 (0.13)***	1.18 (0.14)***	1.01 (0.15)***	
	Armored (Dummy)	0.77 (0.13)***	0.89 (0.14)***	0.97 (0.15)***	
	Derivative (Dummy)	-0.25 (0.13)*	-0.14 (0.13)	-0.02 (0.14)	
Learning/Rate Effects	LN(Cum. Quantity)	-0.09 (0.03)***	-0.11 (0.03)***	-0.12 (0.03)***	
	INT	13.06 (1.75)***	7.5 (1.84)***	3.26 (2.01)*	
"Goodness of Fit" Measure		R-Squared	91.5%	89.6%	86.8%
		Predicted Unit Cost	\$3,008	\$2,292	\$1,626

*** = Significant at 99% Confidence Level
** = Significant at 95% Confidence Level
* = Significant at 90% Confidence Level

Using the regression coefficients from the CER models, you can predict the first lot unit cost of the future program. Assume the following:

- **Work Start:** 2018
- **First Lot Quantity:** 60 units
- **Gross Vehicle Weight (GVW):** 50,200 lbs
- **Max Speed:** 62 MPH
- Is **armored**; is **combat**; is a **derivative**

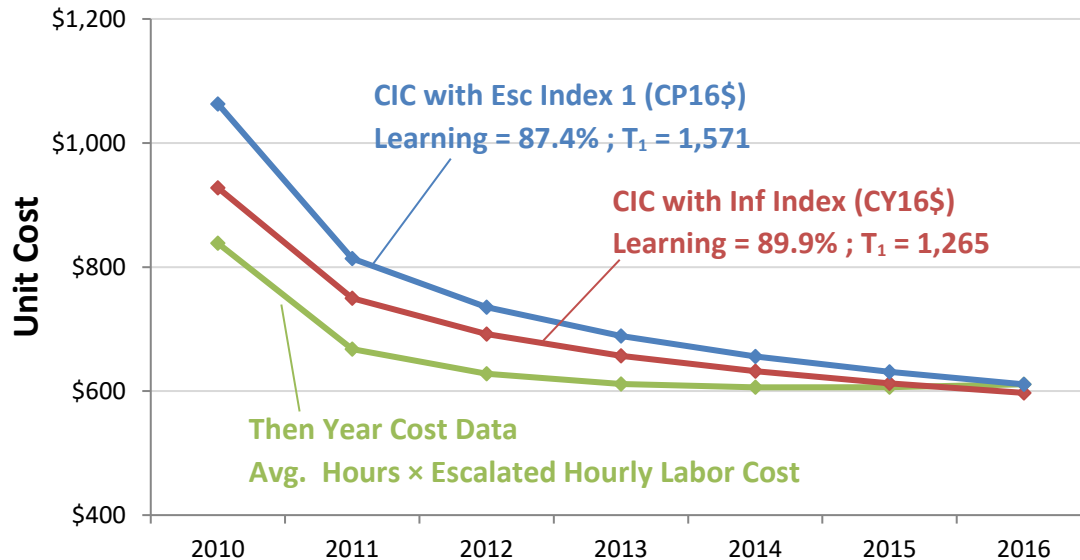
Applying the CP\$ coefficients, the unit cost is CP16 \$3,008. Applying the CY\$ coefficients, the unit cost is CY16 \$2,292. Though the outputs are in different units (one in CP\$ and the other CY\$), the estimates are equivalent to TY\$ if it is assumed that the first production lot were obligated in the base year (here, BY16); in this case, the CP16\$ CER would estimate the average unit cost for the first lot of the new program to be 31% higher than the result of the CY16\$ CER. However, since the work is assumed to start in 2018 using the WTCV appropriation outlay, you multiply the CER results by the 2018 value from the BY16 weighted escalation (for CP\$ CER) and inflation (for CY\$ CER) indices. The final TY\$ results in 2018 are \$3,216 and \$2,361, showing a greater delta between the two methods of 36% due to the anticipated real price change captured in the CP\$ CER.

C. Agreement between perfect-CP\$ CICs and Learning Curves

Note that in Figure 5-8, the estimated learning slope for the CP\$ CIC agreed with the slope of the learning curve using hours. The T₁ costs also agree, though the units have different denominations. Using CY\$, both the estimated learning and T₁ cost are less because the price of labor grew faster than inflation. As a result, the CIC in CP\$ found a

dollar in the past bought relatively more labor hours than CIC in CY\$. More implied hours in the past means the program experienced relatively steeper (greater) learning. Figure E-5 below shows a plot of the analogous data set in TY\$ (green). It also shows the fitted, or regression derived, values from a CIC produced with the “ideal” escalation index provided (CP16\$, blue) and from a CIC produced with an inflation index (CY16\$, red).⁴⁴

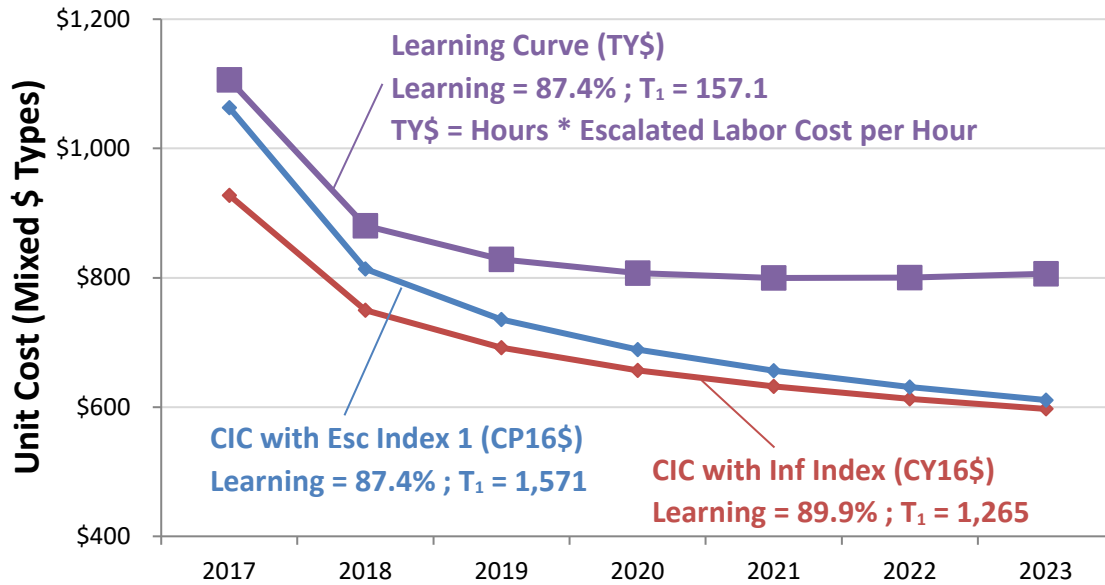
Figure E-5. Analogous data fitted values.



The coefficients from the analogous learning models can also be used to predict the new program’s costs in both CY\$ and CP\$. The predicted values from the regression models, which remain in base year 2016 dollars, are still expressed in different types of dollars: one model is in CP16\$ and the other is in CY16\$. The predicted costs for the new program are displayed in Figure E-6 below, and shown relative to the predictions from the learning curve (based on hours) in TY\$ in purple.

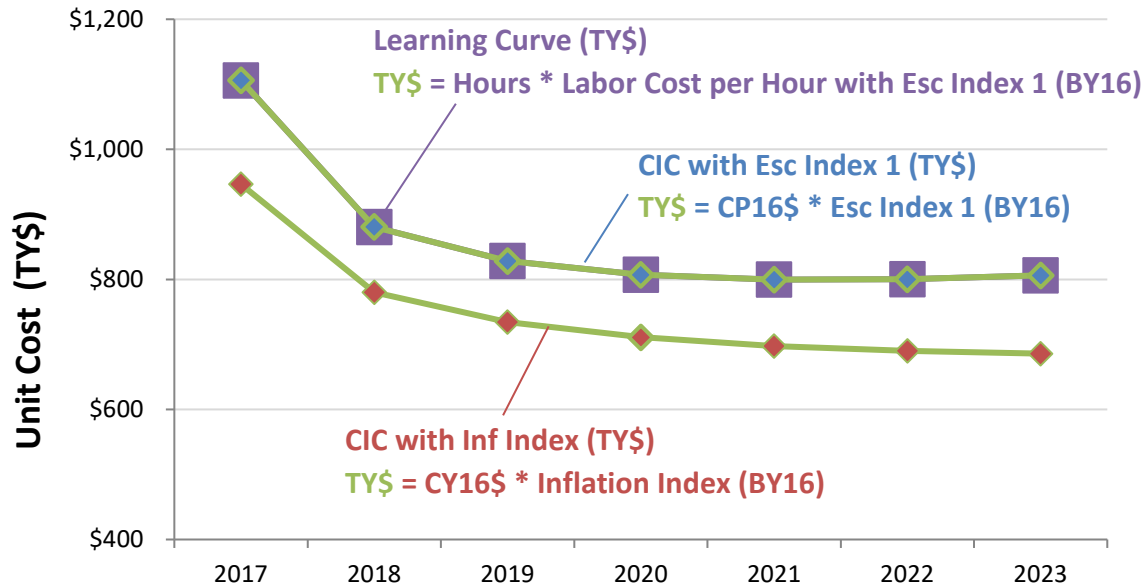
⁴⁴ A further indication that the CY\$ CIC is problematic is that the red curve does not pass through the actual 2016 value, despite the “perfected” data concocted for this example.

Figure E-6. Predicted values for new program.



The final step is to convert predicted costs to TY\$. This is done by applying the projected inflation index values to the CY\$ and the projected escalation index values to the CP\$ for 2017-2023 (see Figure E-7 below). Note that the estimate performed using the CIC built with Escalation Index 1 agrees with the learning curve built using hours. This complete agreement exists because labor costs alone were targeted and perfect information regarding escalation was assumed (i.e., Escalation Index 1 was used, which was derived from the labor rates directly, rather than a more generic index such as Escalation Index 2). The inflation model, on the other hand, underestimated unit costs relative to the learning curve by more than 10 percent.

Figure E-7. New program final then year cost estimates.



In the case where an analogous historical program is used to estimate a future program, the inflation model (after inflation is reapplied) will produce TY\$ which preserve much the same slope relative to the escalation model (after escalation is reapplied). The slope is largely preserved because the regression in CY\$ seeks to produce a mean bias of zero over the relevant quantities. However, the inflation model's TY\$ costs fall below the escalation model's because it neglects the real price change that has occurred between the analogous program and the new.

Appendix F. Policy and Guidance

There are instructions at various levels from OMB down to the Services that address how inflation should be incorporated into cost estimates and budgets. This section discusses these instructions and how to interpret them through the lens of cost estimation.

OMB A-11 and issuances from the OUSD(Comptroller) (OUSD(C)) and Service comptrollers are relevant to determining the top line for budgeting for each appropriation. They also ensure that mandatory programs (such as pay and benefits for military and civilian employees) are funded according to law. Cost analysis is intended to be an accurate representation of what a particular system will cost. This point is reinforced by most budget guidance. Decision-makers typically use the estimated costs of systems to determine how to spend available funds, to identify potential shortfalls, and to make decisions about programs.

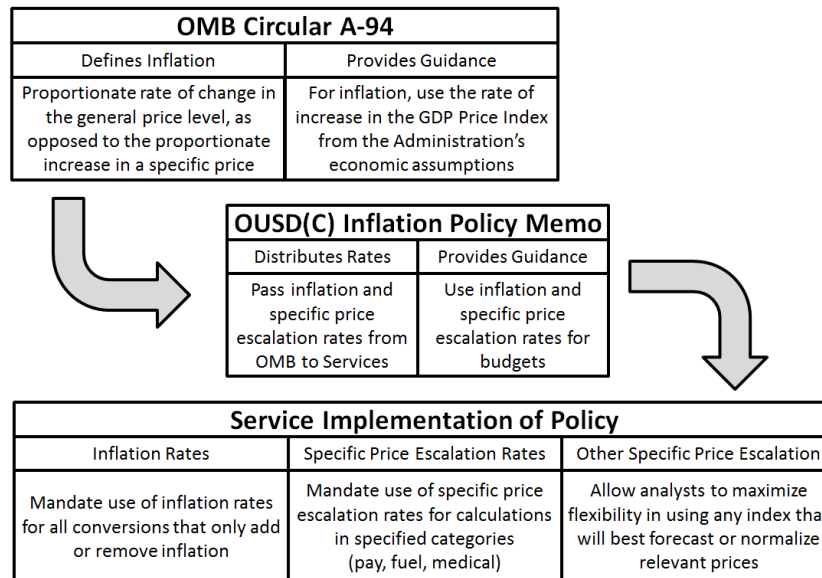
While some of the guidance is complex and can be contradictory, the law states unambiguously that the Department must build realistic cost estimates. This theme is echoed in the instructions from OMB using the less clear wording “Full rate of anticipated inflation.” In our terminology, this means anticipated escalation. The guidance in the DoD FMR has wording that both constrains programs to use OUSD(C)-provided indices and requires analysts to include the most likely or expected full growth in costs. Ultimately, analysts are required by law to develop realistic estimates as required by WSARA, which will require the use of indices that include both inflation and real price change.

Most cost estimators use price indices developed and published by a DoD organization, such as a financial management branch or a cost estimating shop. This chapter outlines how the DoD develops price indices. It will help the analyst distinguish between inflation and escalation indices, regardless of how they are labeled, and thereby help the analyst select an appropriate index for a given analysis.

A. Overview

Figure F-1 below provides an overall perspective of the chain of inflation and escalation policy and guidance. High level guidance and the administration’s economic assumptions are provided by OMB. OUSD(C) converts the GDPPI into rates and provides those rates along with selected specific price escalation indices to the Services. OUSD(C) also mandates use of the rates they provide for budget purposes. The Services then build indices from the rates and otherwise implement the guidance provided by OUSD(C) while allowing flexibility in forecasting so analysts can perform realistic cost estimating.

Figure F-1. Chain of policy.



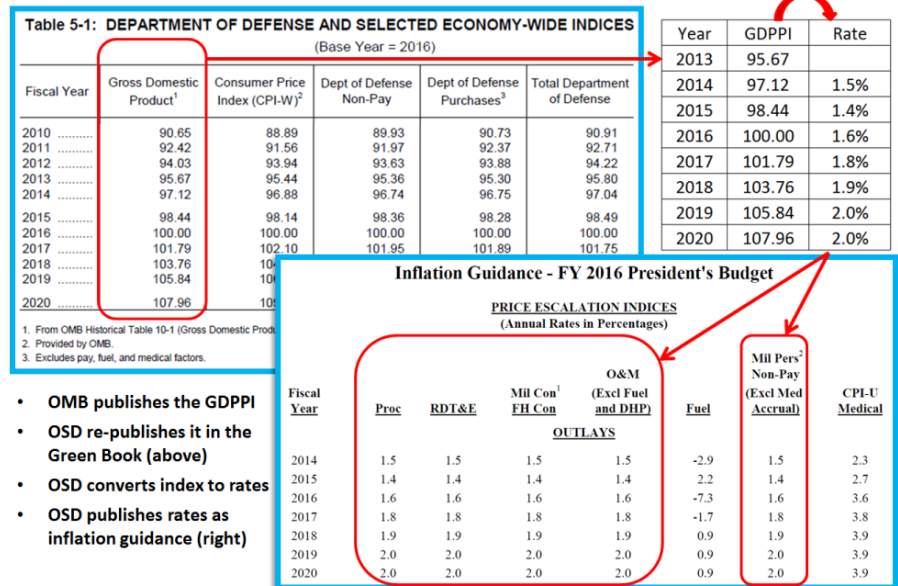
B. Pricing guidance for the President's Budget

Three Executive Branch offices work together to develop economic forecasts to include a forecast of the Gross Domestic Product Chain-Weighted Price Index (GDPPI): the Office of Management and Budget (OMB), the Department of the Treasury, and the Council of Economic Advisers (CEA), informally known together as the "Troika." Federal agencies, including the Department of Defense, use the GDPPI forecast as the inflation forecast for planning purposes and when preparing budget documents. The economic assumptions are recorded in Table 10-1 of the OMB historical tables.⁴⁵

⁴⁵ <https://www.whitehouse.gov/omb/historical-tables/>

OMB provides the inflation forecast to OUSD(C), which uses the forecast as the basis for many of the price growth rates published in its annual “Inflation Guidance.” The congruence between the GDPPI and the Inflation Guidance for the President’s Budget is shown in Figure 17 on the right. Within the guidance, annual rates are the same for: RDT&E; Procurement; Military Construction; O&M (excluding fuel and medical); and Military Personnel (non-pay excluding medical accrual). These rates are the same because they all reflect the GDPPI, which OUSD(C) publishes every year in Table 5-1 of the “Green Book.”

Figure F-2. Source of inflation guidance and select escalation guidance.



The rate guidance provided by OUSD(C) contains price escalation rate guidance for fuel, medical, and government employee pay, in addition to inflation. Like inflation, OUSD(C) receives this guidance from the Troika and provides it to the Services.

C. OMB Circular A-11

OMB Circular A-11 is entitled “Preparation, Submission, and Execution of the Budget.”⁴⁶ Section 31 specifically provides instruction on how to prepare and submit materials required to formulate the President’s Budget (PB).

Section 31.1(a) addresses what should be used as a basis for a budget proposal. The circular states that “In developing the estimates, consider the effect that demographic, economic, or other changes can have on program levels beyond the budget year.”

Section 31.1 (c) addresses the proper economic assumptions to use when developing estimates to be used in the “out years” (the nine years following the budget year). This sub-section states that “OMB policy permits consideration of price changes for goods and services as a factor in developing estimates. However, this does not mean that you should automatically include an allowance for the full rate of anticipated inflation in your

⁴⁶ <https://www.whitehouse.gov/omb/information-for-agencies/circulars/>

request.” In this paragraph, OMB appears to be calling the price change of a particular good or service the “full rate of anticipated inflation.” This would be what we would term “escalation.”

In the following citation from the same sub-section, OMB requires that “mandatory programs” (e.g., social security, government personnel retirement) in the out years are funded for the entire anticipated price change. OMB sees these programs as existing liabilities that must be paid and as such, the entire price increase must be considered.

“For mandatory programs, reflect the full inflation rate where such an allowance is required by law and there has been no decision to propose less than required.”

Conversely, the next citation shows that the OMB allows the Department more flexibility in discretionary programs by allowing the out years to include the full anticipated price increase or something less than the full anticipated price increase. Ultimately, the Department must make decisions among its competing discretionary priorities in order to produce a budget that is consistent with the budget planning guidance levels. (Remember, the ultimate goal of this circular is to facilitate budget preparation.)

“For discretionary programs, you may include an allowance for the full rate of anticipated inflation, an allowance for less than the full rate, or even no allowance for inflation. In many cases, you must make trade-offs between budgeting increases for inflation versus other increases for programmatic purposes. Unless OMB determines otherwise, you must prepare your budget requests to OMB within the budget planning guidance levels provided to you, regardless of the effect of inflation.”

Failure to provide for the full rate of anticipated inflation implies buying less of the item in question. This is allowable for discretionary programs, but not for mandatory programs.

D. OMB Circular A-94

OMB Circular A-94 “Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs”⁴⁷ provides general guidance for conducting benefit-cost and cost-effectiveness analysis. As such, it includes a definition for inflation and recommended inflation assumptions for both within the Future Years Defense Program (FYDP) and forecasting beyond the FYDP.

The OMB definition for inflation is as follows.

⁴⁷ <https://www.whitehouse.gov/omb/information-for-agencies/circulars/>

“Inflation⁴⁸ - The proportionate rate of change in the general price level, as opposed to the proportionate increase in a specific price. Inflation is usually measured by a broad-based price index, such as the implicit deflator for Gross Domestic Product or the Consumer Price Index.”

This definition includes the widely agreed upon concepts for the economic definition of inflation that one would find in any reputable textbook. The important understanding is that inflation is the change in the general price level and not the change in the specific price of any particular good.

OMB’s recommended inflation assumptions are as follows.

“When a general inflation assumption is needed, the rate of increase in the Gross Domestic Product deflator from the Administration's economic assumptions for the period of the analysis is recommended. For projects or programs that extend beyond the six-year budget horizon, the inflation assumption can be extended by using the inflation rate for the sixth year of the budget forecast.”

E. Weapon Systems Acquisition Reform Act of 2009 (WSARA)

Title 10 USC Section 2334 “Independent cost estimation and cost analysis” was created by WSARA.⁴⁹ It emphasizes that indices used by the Department of Defense meet the needs for realistic cost estimating. This means that the best information available should be used to build Then-Year estimates. As such, analysts should not apply an index that they believe will not provide a complete picture of the anticipated cost. Instead, analysts should seek out the best available tools to estimate the future cost of their program. The following citation from this section highlights this point.

(a) IN GENERAL.—The Director of Cost Assessment and Program Evaluation shall ensure that the cost estimation and cost analysis processes of the Department of Defense provide accurate information and realistic estimates of cost for the acquisition programs of the Department of Defense. In carrying out that responsibility, the Director shall ...

(7) periodically assess and update the cost indices used by the Department to ensure that such indices have a sound basis and meet the Department’s needs for realistic cost estimation;....”

⁴⁸ The use of “Full rate of anticipated inflation” in OMB Circular A-11 does not convey the same meaning as the more traditional definition of inflation included in OMB Circular A-94. By adding the language “full rate of anticipated,” the authors of OMB Circular A-11 include the complete price change (escalation), not just inflation.

⁴⁹ <https://www.law.cornell.edu/uscode/text/10/2334>

F. DoD FMR Volume 2A Chapter 1

The guidance in DoD 7000.14-R, the Department of Defense Financial Management Regulation (DoD FMR)⁵⁰ Volume 2A can be contradictory from the perspective of a cost analyst. Consistent with WSARA, section 010303.B.1 of the DoD FMR requires “most likely, or expected cost.”

“It is DoD policy to reflect the most likely or expected full costs (including military and civilian personnel pay) for the current year, the biennial budget years, and outyear estimates for all appropriations.”

However, the DoD FMR then specifies that estimated price level changes will be based on data provided by OUSD (Comptroller). Comptroller does not distribute specific guidance on the anticipated price level changes of individual programs, but the guidance says the indices provided by Comptroller will be updated as economic conditions warrant.

“[This] estimated price level changes will be based on data provided by OUSD (Comptroller). These indices, which will be updated as economic conditions warrant, will be used to (1) determine the amount of price escalation for a procurement line item, major RDT&E system, or construction item over a given time period, and (2) project inflation in other noncompensation areas of all other appropriations.”

In section 010303.B.4, the DoD FMR goes on to say that the budget estimates for goods and services will reflect such things as learning curves and specific price changes:

“Biennial budget estimates for goods and services will in all cases reflect the following considerations: ...

- b. The state of development or production and the learning curve.
- c. Specific price changes, to take effect at a future date -- e.g., a specific and authoritative rate or tariff schedule to take effect on a definite future date, which may involve higher or lower prices than those in effect at the time estimates are prepared.”

Finally, under section 010107 Budget Terminology/Definitions, the definition for Current Service Estimates explicitly states that inflation should not be the only basis for the budget estimate. This means that the budget estimate should include the entire expected price increase of a good or service.

“Current Services Estimates: Estimated budget authority and outlays for the upcoming fiscal year based on continuation of existing levels of service... These estimates of budget authority and outlays, accompanied by the underlying economic and programmatic assumptions upon which they are based (such as the rate of inflation, the rate of real economic growth,

⁵⁰ <http://comptroller.defense.gov/FMR.aspx>

pay increases, etc.), are required to be transmitted by the President to the Congress.”

G. OUSD (Comptroller) annual inflation guidance

OUSD (Comptroller) annually produces guidance on inflation, fuel, medical and government employee pay raise assumptions. The guidance may be a bit confusing because it is labeled inflation guidance, but it also includes price indices for fuel, medical, and pay raises. Figure F-3 shows the guidance distributed for the FY16 President’s Budget.⁵¹ You can see in the figure that the growth rates for Procurement, RDT&E, Military Construction, O&M, and Military Personnel Non-Pay are all the same. That is because these are equal to inflation. The remaining rates are specific price escalation rates.

Figure F-3. Annual Comptroller memo (rates page).

Inflation Guidance - FY 2016 President's Budget							
<u>PRICE ESCALATION INDICES</u>							
(Annual Rates in Percentages)							
<u>Fiscal Year</u>	<u>Proc</u>	<u>RDT&E</u>	<u>Mil Con¹ FH Con</u>	<u>O&M (Excl Fuel and DHP)</u>	<u>Fuel</u>	<u>Mil Pers² Non-Pay (Excl Med Accrual)</u>	<u>CPI-U Medical</u>
<u>OUTLAYS</u>							
2014	1.5	1.5	1.5	1.5	-2.9	1.5	2.3
2015	1.4	1.4	1.4	1.4	2.2	1.4	2.7
2016	1.6	1.6	1.6	1.6	-7.3	1.6	3.6
2017	1.8	1.8	1.8	1.8	-1.7	1.8	3.8
2018	1.9	1.9	1.9	1.9	0.9	1.9	3.9
2019	2.0	2.0	2.0	2.0	0.9	2.0	3.9
2020	2.0	2.0	2.0	2.0	0.9	2.0	3.9
<u>BUDGET AUTHORITY³</u>							
2014	1.6	1.5	1.6	1.5	-2.9	1.5	2.6
2015	1.7	1.5	1.8	1.6	2.2	1.4	3.1
2016	1.8	1.7	1.9	1.7	-7.3	1.6	3.7
2017	1.9	1.9	2.0	1.9	-1.7	1.8	3.8
2018	2.0	2.0	2.0	2.0	0.9	1.9	3.9
2019	2.0	2.0	2.0	2.0	0.9	2.0	3.9
2020	2.0	2.0	2.0	2.0	0.9	2.0	3.9
<u>PAY RAISE ASSUMPTIONS⁴</u>							
	<u>ECI⁵</u>		<u>Military</u>		<u>Civilian</u>		
2014	1.8		1.0		1.0		
2015	1.8		1.0		1.0		
2016	2.3		1.3		1.3		
2017	-		1.3		1.3		
2018	-		1.5		1.5		
2019	-		1.5		1.5		
2020	-		1.8		1.8		

1. Use for Chemical Demilitarization Construction, Defense-Wide.

2. Not to be used to inflate accounts fixed by statute.

3. These are composite rates at the P.L. title level. Inflation rates for specific accounts are a function of their spendout profiles and will vary within each title. DWCF activities use these rates for non-pay inflation.

4. Pay raises are effective January 1 of each year.

5. Employment Cost Index; for use in setting the by-law (37 U.S.C. 1009) military pay raise.

⁵¹ https://www.ncca.navy.mil/tools/FY2017_PB_Inflation_Guidance.pdf

The Annual Comptroller Inflation Guidance includes not only rates but also outlay profiles from which the weighted indices are built. Figure F-4 shows some of the outlay profiles distributed for the FY16 President's Budget. For a detailed explanation on how weighted indices are constructed using an outlay profile, see Chapter 7 section E. While that use case is intended to address escalation indices, the mechanical calculations are the same for inflation. One important note is that the outlay rates exclude pay and fuel dollars (as is documented at the top of each outlay profile page in the memo). This means that the weighted indices developed using these outlay profiles do not include pay and fuel. Since pay and fuel do not commonly experience price escalation beyond the year of appropriation, they should be adjusted using the raw index.

Figure F-4. Annual Comptroller memo (outlay rates page).

Outlay Rates To Be Used For Incremental Changes in BA Purchases (As Percent of BA Purchases; Excludes Pay and Fuel Dollars)										
	FIRST YEAR	SECOND YEAR	THIRD YEAR	FOURTH YEAR	FIFTH YEAR	SIXTH YEAR	SEVENTH YEAR	EIGHTH YEAR	NINTH YEAR	TENTH YEAR
<u>Military Personnel</u>										
Army	79.51	17.24	3.25							
Navy	85.16	11.87	2.97							
Marine Corps	81.45	18.55								
Air Force	83.86	16.14								
Army Reserve	67.16	21.78	11.06							
Navy Reserve	75.76	24.24								
Marine Corps Reserve	78.94	21.06								
Air Force Reserve	77.93	22.07								
Army National Guard	70.96	29.04								
Air National Guard	84.33	15.67								
<u>Operation and Maintenance</u>										
Army	28.94	53.30	13.15	1.95	2.66					
Navy	48.25	39.72	8.20	2.19	1.64					
Marine Corps	34.68	51.65	11.28	2.39						
Air Force	41.46	43.78	10.25	2.61	1.90					
Defense-Wide	49.00	42.55	4.87	2.15	1.43					
Inspector General	32.22	61.00	3.39	3.39						
Army Reserve	39.14	46.25	9.89	3.04	1.68					
Navy Reserve	55.41	38.64	2.68	2.23	1.04					
Marine Corps Reserve	48.05	38.69	8.84	3.32	1.10					
Air Force Reserve	45.17	46.06	5.48	1.32	1.97					
Army National Guard	49.20	40.02	6.93	1.69	2.16					
Air National Guard	53.05	38.25	3.48	2.26	1.22	1.74				
Overseas Contingency Ops	60.00	25.00	10.00	3.50	1.50					
Court of Appeals, Armed Forces	57.22	31.33	7.13	4.32						
Drug Interdiction	43.44	49.52	5.15	1.89						
Defense Health Program	62.34	25.02	11.05	1.59						
Environmental Restoration	40.00	40.00	15.00	5.00						
Overseas Humanitarian	15.70	26.90	32.00	15.00	7.00	3.40				
Cooperative Threat Reduction	5.00	50.00	22.00	13.50	9.50					
<u>Procurement: Army</u>										
Army Aircraft	9.70	40.20	28.80	15.40	2.70	1.10	1.10	1.00		
Army Missiles	7.20	35.80	30.60	18.00	5.60	1.70	0.50	0.60		
Army W&TCV	6.30	31.90	31.40	21.10	5.80	2.30	0.50	0.70		
Army Ammunition	6.70	35.70	34.60	13.20	4.40	2.50	1.80	1.10		
Army Other	12.10	42.90	29.00	7.00	4.00	3.00	1.00	1.00		
JIEDDO	16.60	51.40	22.30	4.70	3.00	1.00	1.00			
Chemical Agents and Mun	40.00	30.00	15.00	8.00	4.00	2.00	1.00			
<u>Procurement: Navy</u>										
Navy Aircraft	14.50	34.00	32.00	9.00	4.00	3.00	2.00	1.50		
Navy Weapons	18.00	30.20	26.50	12.80	6.50	3.50	1.50	1.00		
Navy & MC Ammunition	8.30	32.40	29.30	16.00	7.00	4.00	2.00	1.00		
Navy Shipbuilding	8.40	24.40	19.50	16.70	12.00	9.00	6.00	2.00	1.00	1.00
Navy Other	20.50	42.10	21.10	7.30	4.50	2.00	1.50	1.00		
Procurement, Marine Corps	13.00	42.00	27.20	10.90	3.50	1.40	1.00	1.00		

Beginning in 2020, OSD CAPE released an addendum to the above memorandum that recommended outyear escalation rates for certain cost elements such as military pay and fuel.

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-3.93a

Respondent: B. Hill

Page: 1 of 1

Question: 93. Refer to lines 4-14 on page 23 of Mr. Hill's direct testimony on the portable generator program during power outages. Please:

a. Provide a full description of how the program would work, such as who would qualify, who would deliver and install the generator, whether the installation will be to the customer circuit breaker or by extension cords to specific appliances.

Answer: The Company generates a list of customers (identified to likely be out of power for greater than 48 hours) that it contacts during extended storms. Customers identified as senior citizens, low-income, and those with medical needs are prioritized for generator deployment.

DTE personnel (not field personnel such as linemen which work on storm restoration) and contractors deliver and install the generators. Installation is performed with extension cords and is not connected to customer circuit breakers.

Attachment: N/A

MPSC Case No: U-21534

Requester: AG

Question No.: AGDE-3.95b

Respondent: B. Hill

Page: 1 of 1

Question: 95. Refer to page 1 of Exhibit A-12, Schedule B5.4, pertaining to the Base Capital Programs. Please:
b. For line 6, explain and show how you arrived at the reduction amounts for 2024 and 2025 as a result of the strategic program spending.

Answer: The savings were calculated by estimating event reductions. Please see attached file.

Attachment: U-21534 AGDE-3.95b-01 Emergent Savings 2024-2025

Cost Per Event (2023) \$ 2,109
Inflation Rate 1.04

Baseline	Events		Event Delta from baseline		Emergent Savings	
	2024	2025	2024	2025	2024	2025
205,336	195,844	195,939	9,492	9,397	\$ 20,819,951	\$ 21,435,815

MPSC Case No: U-21534

Requester: MNSC

Question No.: MNSCDE-7.1c

Respondent: S. Hartwick

Page: 1 of 1

- Question:**
1. Refer to Exhibit A-23, Schedule M7 (S. Hartwick) at page 47, which states, regarding Distribution Automation, “The 2024 Distribution Automation Plan is composed of the investments included in the IRM in Case No. U-21297, which is 63 circuits and 189 reclosers, plus an additional 96 reclosers that are expected to improve 32 circuits on the 4.8 kV distribution system. In addition, engineering and design work will be completed in 2024 for 240 reclosers covering approximately 80 circuits to be constructed in 2025. In 2025, 578 reclosers across an estimated 242 circuits will be constructed based on the prioritization model developed in 2023 and 480 reclosers and 160 circuits are expected to undergo engineering and design in 2025 for 2026 construction.”
- c. Provide a list of the 242 circuits to be constructed in 2025. Identify any already approved as part of the IRM, and those for which the Company is seeking IRM cost recovery.

Answer: See the attachment for a preliminary list of 2025 circuits included in the Distribution Automation program. The preliminary list for 2025 is subject to change based on an engineering and design evaluation, customer or system needs, or efficiencies determined by the Company. Note the list of 2025 circuits includes planned work associated with the instant rate case. Additionally, circuits will be constructed under the IRM.

The IRM was established in Case No. U-21297 in the MPSC Order pages 284-291. Pursuant to the Order, the Company will publish a list of circuits to be constructed in the IRM four months prior to the start of the IRM plan year.

Attachment: U-21534 MNSCDE-7.1c 2025 Rate Case Circuit List.xlsx

Circuit	Program Year
PULFD0420	2025
PULFD2111	2025
PULFD0393	2025
PULFD2155	2025
PULFD2175	2025
WDSID1150	2025
WDSID2757	2025
WDSID1151	2025
WDSID2660	2025
TWEMI1551	2025
TWEMI1938	2025
TWEMI0010	2025
DENVR1341	2025
DENVR2222	2025
DENVR2148	2025
DENVR1260	2025
DENVR1596	2025
DENVR1353	2025
OUTDR1304	2025
OUTDR1290	2025
OUTDR1308	2025
OUTDR1313	2025
OUTDR1312	2025
YPSIL0317	2025
YPSIL0305	2025
YPSIL0314	2025
YPSIL0318	2025
ALMOT0304	2025
APPOL1327	2025
APPOL2076	2025
APPOL1318	2025
TWEMI0358	2025
TWEMI1580	2025
TWEMI0355	2025
TWEMI0002	2025
TWEMI0001	2025
ANNCH1361	2025
ANNCH2129	2025
ANNCH1373	2025
ANNCH1588	2025
APPOL1270	2025
APPOL2150	2025
APPOL1142	2025
APPOL1335	2025
CHAND2024	2025
CHAND1213	2025

CHAND2102	2025
CHAND1100	2025
CHAND0072	2025
VENIC1514	2025
VENIC1475	2025
VENIC2282	2025
COOLG1071	2025
COOLG1402	2025
COOLG2204	2025
COOLG2203	2025
COOLG0060	2025
MCGRW1167	2025
MCGRW1048	2025
MCGRW1201	2025
GLEND1513	2025
GLEND2025	2025
GLEND1417	2025
GLEND0608	2025
MANDY2764	2025
MANDY2805	2025
MANDY0307	2025
MANDY2724	2025
MANDY1390	2025
MANDY0893	2025
SCOTN2012	2025
SCOTN0027	2025
SCOTN1324	2025
SCOTN1311	2025
SCOTN1018	2025
LAMBT1524	2025
LAMBT2082	2025
LAMBT1456	2025
LAMBT1485	2025
LAMBT1449	2025
LAMBT1432	2025
WEBST1948	2025
WEBST0373	2025
WEBST1812	2025
WEBST1809	2025
WEBST1875	2025
DENVR1462	2025
DENVR1338	2025
DENVR2094	2025
DENVR1329	2025
HAWTH1841	2025
HAWTH2112	2025
HAWTH2071	2025

HAWTH1301	2025
SPKNE9056	2025
SPKNE9108	2025
SPKNE8820	2025
SPKNE8837	2025
CLYDE9079	2025
CLYDE8910	2025
PERU 9432	2025
PERU 9444	2025
DRAKE8969	2025
DRAKE9117	2025
DRAKE9074	2025
BLCRK9344	2025
BLCRK9330	2025
BLCRK9351	2025
CHEST8430	2025
CHEST8417	2025
MOTT 9789	2025
MOTT 8107	2025
MOTT 9782	2025
MALRD9393	2025
MALRD9384	2025
MALRD9419	2025
STEPH8522	2025
STEPH8669	2025
STEPH8415	2025
SHELD8190	2025
SHELD9398	2025
WOLFH8838	2025
DUBLN8205	2025
CASVL8805	2025
BELVL9356	2025
GLBRT9373	2025
GLBRT8106	2025
ZACRY9502	2025
MILFD9249	2025
MILFD9245	2025
MILFD9247	2025
ALGON8073	2025
ALGON0304	2025
ALGON0301	2025
WAYNE9366	2025
WAYNE9446	2025
WAYNE9447	2025
WAYNE9435	2025
STATE8137	2025
STATE9809	2025

STATE8115	2025
STATE8148	2025
COLNS9829	2025
COLNS9868	2025
COLNS9894	2025
COLNS9870	2025
WSTLD8162	2025
WSTLD8170	2025
WSTLD9494	2025
MALRD9387	2025
MALRD9375	2025
CASVL8819	2025
HANCK8198	2025
HANCK9023	2025
HANCK8136	2025
HANCK9078	2025
HANCK8235	2025
WDLOW8255	2025
KENSL9858	2025
KENSL9770	2025
AKRON9000	2025
AKRON9321	2025
AKRON8964	2025
AKRON8971	2025
AKRON8992	2025
HINES9459	2025
HINES9423	2025
HINES9416	2025
HINES9452	2025
HINES9339	2025
HINES9341	2025
LARDO8973	2025
LARDO8949	2025
ORION9080	2025
ORION9071	2025
LAPER8785	2025
LAPER8765	2025
PERU 9441	2025
PERU 9440	2025
WSTLD8002	2025
WSTLD9500	2025
WSTLD9335	2025
WSTLD8184	2025
SLOAN8524	2025
SLOAN8527	2025
SLOAN8709	2025
SLOAN8530	2025

SLOAN8529	2025
PHENX9821	2025
PHENX9846	2025
DEWEY8085	2025
DEWEY8259	2025
NBURG9348	2025
NBURG9465	2025
NBURG9454	2025
NBURG9412	2025
NBURG8044	2025
SALIN9788	2025
SALIN9840	2025
SALIN9801	2025
TEGER9122	2025
TEGER8872	2025
TEGER8834	2025
TAMRK9031	2025
TAMRK9067	2025
TAMRK9055	2025
CONRD8130	2025
PIONR9795	2025
PIONR9793	2025
PIONR9830	2025
MEDNA8477	2025
MEDNA8525	2025
MEDNA8412	2025
SLKRK9772	2025
SLKRK9828	2025
BUNRT8426	2025
BUNRT8419	2025
BUNRT8108	2025
MAUME8241	2025
MAUME8088	2025
MAUME8082	2025
NEAST8631	2025
NEAST8712	2025
TEGER8845	2025
TEGER8853	2025
TEGER9133	2025
FLINT9784	2025
FLINT9797	2025
FLINT9837	2025
APACE8996	2025
APACE9014	2025
APACE9072	2025
APACE9017	2025
BENSN8407	2025

BENSN8418	2025
BENSN8445	2025
BENSN8542	2025
TAMRK9545	2025
TAMRK9070	2025
NBURG8060	2025
NBURG8075	2025
NBURG8052	2025

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File #:	24-1200	Version: 2	Name:	7/15/24 - LED Streetlight Conversion
Type:	Resolution		Status:	Passed
File created:	7/15/2024		In control:	City Council
On agenda:	8/8/2024		Final action:	8/8/2024
Enactment date:	8/8/2024		Enactment #:	R-24-326
Title:	Resolution to Accept Carbon Reduction Program Grant Funds from Southeast Michigan Council of Governments, Execute a Contract with DTE Energy to Convert DTE Streetlights to LED Technology (\$1,250,000.00) and Appropriate Funding (8 Votes Required)			
Attachments:	1. Attachment 1 to Purchase Agreement-Streetlight Locations Map.pdf , 2. LED Conversion Cut Sheet-58w 2700K LED.pdf , 3. 24DTEStreetlightLEDNarrative.pdf , 4. CRP SignaturePage.pdf , 5. CRP Program Applicatin.pdf , 6. Staff Memo - 8.8.24 CC Meeting Item DC-1 - DTE LED Conversion Project.pdf , 7. REVISED Purchase Agreement - HID Conversion - City of Ann Arbor-Revised 8-1-24.pdf , 8. GCM2 58w 2700K with House Side Shield Photometrics.pdf , 9. GCM H-Series House-Side-Shield-Drawing.pdf , 10. Purchase Agreement - HID Conversion - City of Ann Arbor-06032024.pdf			

[History \(5\)](#) [Text](#)

Title

Resolution to Accept Carbon Reduction Program Grant Funds from Southeast Michigan Council of Governments, Execute a Contract with DTE Energy to Convert DTE Streetlights to LED Technology (\$1,250,000.00) and Appropriate Funding **(8 Votes Required)**

Memorandum

Attached for your review and consideration is a resolution authorizing acceptance of Carbon Reduction Program grant funds, and authorizing execution of a contract with DTE Energy, to convert DTE streetlights to Light Emitting Diode (LED) technology.

There are over 9,000 streetlights in the City of Ann Arbor public rights-of-way, with the majority - over 5,000 - owned and maintained by DTE Energy. A majority of the DTE streetlight subgroup - 4,087 - use high pressure sodium (HPS) technology, which is becoming obsolete. Conversion of all streetlights to light-emitting diode (LED) technology would be 1.2-3 times more efficient and has been a policy goal of the City's for several years, most recently formalized in the A²Zero Carbon Neutrality plan. In addition to the positive environmental impact due to less electricity used by LED streetlights, a conversion would also result in ongoing financial savings through reduced energy use resulting in lower cost burden to the City to lease these assets from DTE. Lastly, the conversion is expected to result in less outages since LED streetlights have generally been shown to be more reliable and have a longer lifespan than other fixture types.

In 2021, City staff asked DTE to prepare an estimate of the cost required to convert all remaining HPS lights to LED. The project cost estimate provided at that time was \$1.24 million, without a clear funding source for the upfront capital costs. In 2023, staff were able to find a funding source to assist with 80% of the capital costs of the project by applying for the newly established Carbon Reduction Program grant administered by the Southeast Michigan Council of Governments (SEMCOG).

Prior to the implementation of the citywide conversion, staff identified a potential issue in the specific LED streetlight fixture that has been used as a standard by DTE in past years: the streetlight's color temperature. While City owned LED streetlights and DTE non-LED streetlights have typically been a "warmer" color temperature (2700-3000K), DTE's standard LED fixture is a "cooler" 4000K. This issue, as well as the concern that the wattage of DTE's standard fixtures may be higher, were raised by community advocates interested in both preserving "dark skies" by reducing extraneous light pollution and reducing municipal energy usage more generally.

To gauge community support for different lighting options, staff worked with DTE to install streetlights with different wattage/color temperature combinations. These combinations were informed by discussions with community advocates as well as public feedback received by staff to existing 4000K lights. Staff created a [webpage](https://www.a2gov.org/departments/engineering/transportation/Pages/LED-Streetlight-Conversion-Project-(DTE).aspx) [https://www.a2gov.org/departments/engineering/transportation/Pages/LED-Streetlight-Conversion-Project-\(DTE\).aspx](https://www.a2gov.org/departments/engineering/transportation/Pages/LED-Streetlight-Conversion-Project-(DTE).aspx) and public engagement opportunity to collect feedback on these options, ultimately recommending a 58W/2700K streetlight fixture as the citywide default. Staff have noted that in certain cases - in particular, along major roads at uncontrolled crosswalks - higher wattages and/or color temperatures would still be required for reasons of pedestrian safety and visibility, which would be served through DTE's standard LED fixtures.

As noted on the project webpage's FAQ, a number of factors went into the final decision to select the 58W/2700K streetlight fixtures. First, these light fixtures being owned and maintained by DTE is an inherent limitation on the City's control in this space. Furthermore, as these fixtures represent a special-order item with DTE, there are additional operational impacts to consider. While there is no additional cost for the proposed fixture type, DTE does not stock them directly; in order to perform routine maintenance and replacement in a timely fashion, DTE requires that the City procure and stock additional fixtures beyond the quantity of 4,087 lights that will be converted. This complicates the possibility of ordering multiple types of light fixtures - as requested by some advocates and members of the public through engagement effort - which would require additional staff capacity to assure that the correct fixture is installed in each location, as well as maintaining a stock of multiple types of lights. After negotiations with DTE and internal staff discussion, staff recommend procuring an additional 80 fixtures as overstock (approximately 2% of the total quantity).

As the grant funding provided by the Carbon Reduction Program is intended to be obligated in federal fiscal year 2024 (ending September 30, 2024), prompt Council action is requested to ensure that project funding is not jeopardized by delay. City staff have been informed that if the project were not obligated in FY24, the next opportunity would be in FY27, with an uncertain prospect of success.

Budget/Fiscal Impact: The total project is anticipated to not exceed \$1,250,000.00. Grant funding through the Carbon Reduction Program will account for 80% (\$980,000.00) of the total capital project cost. A local match is required for the remaining 20% (\$245,000.00) and an additional \$25,000.00 will be needed to procure the overstock. The City's total contribution of \$270,000.00 will be paid through Climate Action Millage fund. Note that this amount reflects the grant award and anticipated overstock costs. These project costs may come down as further refinement of the number of streetlights slated for upgrade as part of this project change. Operational savings are estimated to be over \$300,000.00 annually. Consequently, the return on investment for the City's match to this project may be realized in as little as one year.

Staff

Prepared by: Nicholas Hutchinson, City Engineer
Skye Stewart, Public Services Area Chief of Staff
Reviewed by: Sue F. McCormick, Interim Public Services Administrator
Approved by: Milton Dohoney Jr., City Administrator

Body

Whereas, The City's 2020 A²Zero Carbon Neutrality Plan outlines a specific action related to powering street lighting and traffic signals with LED technology;

Whereas, A significant majority of remaining non-LED streetlights are owned and maintained by DTE Energy;

Whereas, Conversion of the 4,087 remaining non-LED DTE streetlights requires a capital investment be made to DTE;

Whereas, City staff have received grant funding through the Carbon Reduction Program for 80% of the project's initial cost estimate, requiring the remaining 20% and any additional costs to be borne by the City;

Whereas, The conversion of DTE's streetlights to LED is expected to realize an operational cost savings to the City of \$300,000.00 annually under the current rate structure;

Whereas, This project must be obligated in federal fiscal year 2024 in order to accept Carbon Reduction Program grant funding; and

Whereas, Public engagement was conducted to determine preferences among streetlight fixtures with different color temperature and wattages and this suggested action is consistent with that feedback;

RESOLVED, That the City Council accept the Carbon Reduction Program grant funding in the amount of \$980,000.00 from SEMCOG to support the conversion of DTE streetlights to LED technology and provide the local match of \$270,000.00;

RESOLVED, That the City Council approve the Purchase Agreement with DTE Energy for LED streetlight conversion in an amount not to exceed \$1,250,000.00, to convert most streetlight fixtures to LED with a wattage of 58W and a color temperature of 2700K;

RESOLVED; That City Council appropriates \$980,000.00 to the FY25 Engineering Budget in the Major Grants Programs fund with the source of revenue being the Carbon Reduction Program grant from SEMCOG;

RESOLVED; That City Council appropriates \$270,000.00 to the FY25 Engineering Budget in the Major Grants Programs fund with the source of revenue being the Climate Action Millage fund;

RESOLVED, That City Council's approval is based on the understanding that DTE will, at the time of installation and at no additional cost to the City, utilize luminaires that meet shielding criteria as determined by the City to minimize light trespass or glare onto private property, to the extent practicable, and Council further directs the City Administrator to request that the Purchase Agreement be amended to reflect this understanding;

RESOLVED; That all amounts herein are without regard to fiscal year;

RESOLVD, That the Mayor and City Clerk be authorized and directed to execute said agreements after approval as to form by the City Attorney and approval as to substance by the City Administrator; and

RESOLVED, That the City Administrator be authorized to take the necessary administrative actions to implement this resolution.

As Amended and Postponed by Ann Arbor City Council on July 15, 2024