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**An Assessment of Anomalies in the
EEI Data Base on Power
Plant Performance**

R. L. Simard

OAK RIDGE NATIONAL LABORATORY
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R. L. Simard

ABSTRACT

Annual summary data on power plant performance factors were obtained from the Edison Electric Institute (EEI). Preliminary checks showed many inconsistencies such as annual availability factors less than the corresponding capacity factors. More detailed checking of sample raw outage data as reported to the EEI revealed discrepancies in the raw data and deficiencies in the handling of the data by the EEI computer programs.

BACKGROUND

In 1977, the Federal Energy Administration (now DOE) purchased from the Edison Electric Institute (EEI) its historical power-plant performance data base. The data base covers the years 1957 through 1975 and includes approximately 14,000 unit years of performance data for some 1000 units of 2 MW(e) and larger.

In 1977 ORNL, under contract to the DOE, performed some preliminary analysis of the EEI data for 400 MW(e) and larger coal and nuclear units. The results are reported in DOE/ERA-0007 "Interim Report on the Performance of 400 Megawatt and Larger Nuclear and Coal-Fired Generating Units," April 1978.

In analyzing the EEI data, ORNL identified some anomalies in the data which showed up as inconsistencies among the equivalent availability factor (EAF), availability factor (AF) and capacity factor (CF) and which appeared, at first, to be related to the method used in computing available hours. The nature and extent of the anomalies are discussed in more detail in DOE/ERA-0007.

In 1978 EEI submitted revised data to DOE in which the availability factor was computed by the same method used by EEI for the annual report of the Equipment Availability Task Force, EEI Prime Mover's Committee (EATF/PMC). Subsequent review of the revised data by ORNL showed that the previously observed anomalies still were present. Due to serious

constraints on manpower, EEI was unable to undertake an effort to find the source of the anomalous data.

In response to DOE's offer of assistance, EEI has made available 20 unit years of the raw outage data from which the EEI data base is derived. From these raw data, four unit years of data were selected for a detailed review by ORNL. This report presents the findings of that review, conclusions regarding the EEI data base, and recommendations.

SCOPE OF THE DATA RECEIVED FROM EEI

The data were received from EEI on magnetic tape. The tape contained approximately 14,000 unit years of performance data, covering the years 1957-75, for some 1,000 units 2 MW(e) and larger. Subsequently, a second magnetic tape, covering the years 1960-76, for nuclear units 450 MW(e) and larger and fossil units 100 MW(e) and larger, was also received.

On these tapes, each unit was described by design data, e.g., name-plate rating, date of commercial operation, and annual performance data for each calendar year beginning at the date of commercial operation. The tape included the following, for each calendar year,

1. year,
2. maximum dependable capacity (MDC) for that year,
3. period hours (PH),
4. service hours (SH),
5. available hours (AH),
6. forced outage hours (FOH),
7. planned outage hours (POH),
8. maintenance hours (MH),
9. availability factor (AF),
10. equivalent availability factor (EAF),
11. forced outage rate (FOR),
12. capacity factor (CF).

On the first tape all of the data were derived using the standard EEI definitions as set forth in the Equipment Availability Data Reporting

Instructions prepared by the Equipment Availability Task Force of the Prime Movers Committee.

An analysis of the data on the first tape uncovered various anomalies such as

1. availability factors less than the corresponding capacity factors,
2. service hours exceeding available hours, and
3. negative availability factors.

The source of the anomalies was believed, at first, to be in the available hours. The EEI definition for available hours is:

$$AH = SH + RSH$$

where SH is the service hours and RSH is the reserve shutdown hours. This definition is not used by EEI in its quarterly and annual reports on equipment availability because EEI felt that the data on RSH were unreliable due to incomplete and inaccurate reporting. Instead, EEI has been deriving available hours as the period hours less the outage hours, viz.,

$$AH = PH - FOH - POH - MH$$

This method of computing AH was used by EEI in the second data tape. However, the anomalies found in the data on the first tape were also present in the data on the second tape, and it was then felt that the source must be in the raw data.

The raw data were obtained for 20 of the units for which anomalies were observed in the summary data. From this data base, one year's raw data for each of four units was selected for analysis. The four years of data selected to be reviewed were chosen solely on the basis of the amount of raw data. To keep the analysis effort small, years were chosen in which the number of reported outages was small (less than 50). The four units are identified as Units 1, 2, 3, and 4, and the raw data for these units are tabulated in Tables 1-4, respectively.

RESULTS OF ANALYSIS OF RAW OUTAGE DATA

Table 1 summarizes the outage data for Unit #1, a 525 MW(e) coal-fired unit. The availability factor for 1974 was calculated by the EEI computer program from the forced outage hours, planned outage hours, and maintenance hours as follows

$$\begin{aligned} AH &= PH - FOH - POH - MH \\ &= 8760.0 - 330.2 - 3344.4 - 14.7 \\ &= 5070.7 \end{aligned}$$

$$\begin{aligned} AF &= \frac{AH}{PH} \times 100\% \\ &= \frac{5070.7}{8760.0} \times 100\% \\ &= 57.9\% \end{aligned}$$

but the footnotes to Table 1 point out that in tallying the outage hours, the EEI program failed to flag the following occurrences.

1. Forced outage #9 and forced outage #10 cover the same time interval. The program tallied them both thus biasing FOH by 45.88 hours.
2. Forced outages #7 and #8 were reported as occurring during an interval when the unit was supposed to be out of service due to a planned outage (#10 on Table 1B), thus biasing FOH by 48.98 hours.
3. There are two outages labeled #10, one forced (Table 1A) and one planned (Table 1B), which occur at different times, contrary to reporting instructions.
4. Planned outage #4 overlaps planned outages #5 (17.02 hours) and #6 (6.25 hours). The EEI program counted them all, biasing POH by 23.27 hours.
5. Planned outage #10 overlaps planned outage #4. The EEI program counted them both, biasing POH by 1198.0 hours.

The net result is that 1316.38 outage hours were incorrectly charged against the unit. Correcting the availability factor gives

$$AH = 8760.0 - 235.37 - 2123.10 - 14.68$$

$$= 6386.85$$

$$AF = \frac{6386.85}{8760.0} \times 100\%$$

$$= 72.9\% \text{ (vs } 57.9\% \text{ reported) .}$$

Table 2 summarizes the outage data for Unit #2, an 810 MW(e) nuclear unit. The availability factor for 1975 was calculated by the EEI computer program as

$$AH = PH - FOH - POH - MH$$

$$= 8760.0 - 1092.6 - 3102.6 - 1825.7$$

$$= 2739.1$$

$$AF = \frac{AH}{PH} \times 100\%$$

$$= \frac{2739.1}{8760.0} \times 100\%$$

$$= 31.3\%$$

but the footnotes to Table 2 point out that in tallying the outage hours, the EEI program failed to flag the following occurrences.

1. Planned outage #2 was reported as occurring during planned outage #1. The EEI program counted them both, biasing POH by 1463.98 hours.
2. Maintenance outage #5 is the same as forced outage #4. The EEI program counted them both, biasing MH by 328.52 hours.

This means that 1792.5 outage hours were incorrectly charged against the unit. Correcting the availability factor gives

$$AH = 8760.0 - 1092.60 - 1638.60 - 1497.20$$

$$= 4531.60$$

$$AF = \frac{4531.60}{8760.0} \times 100\%$$

$$= 51.7\% \text{ (vs } 31.3\% \text{ reported) .}$$

Table 3 summarizes the outage data for Unit #3, a 665 MW(e) coal-fired unit. The availability factor for 1974 was calculated by the EEI computer program as

$$AH = PH - FOH - POH - MH$$

$$= 8760.0 - 320.6 - 5549.6 - 3151.6$$

$$= -261.8$$

$$AF = \frac{AH}{PH} \times 100\%$$

$$= -\frac{261.8}{8760.0} \times 100\%$$

$$= -3.0\% \text{ (+3.0\% reported since program fails to check for non-negative values)}$$

but the footnotes to Table 3 point out that in tallying the outage hours, the EEI program failed to flag the following occurrences.

1. Two sets of forced outages and planned outages (labeled #3 and #4) are reported as occurring at different times, which is contrary to the reporting instructions since outages should be numbered consecutively.
2. There are two forced outages labeled #7 which occur at different times, which is contrary to the reporting instructions since two distinct outages should not have the same number.
3. There are several forced outages which are reported more than once. (#4 and 5, #7 and 8, #9, 10, and 11, #12 and 13, #13 and 14, #15 and 16, #17 and 18). Several of these have been tallied incorrectly by the EEI program.
4. Planned outage #4 is the same as planned outage #3. The EEI program counted them both, biasing POH by 2692.25 hours.
5. Planned outage #8 is the same as maintenance outage #9. The EEI program counted them both, biasing MH by 165.08 hours.
6. Even including outage #9, there were only three maintenance outages reported, totaling 515.20 hours. But the EEI reported 3151.6 maintenance hours for that year.

Excluding forced outages #4, 7, 9, 10, 11, 13, 14, 16, and 18 (representing a total of 102.35 hours), planned outage #4, and maintenance outage #9 from the tally, and correcting the availability factor gives

$$\begin{aligned} AH &= 8760.0 - 248.29 - 2857.38 - 350.12 \\ &= 5304.21 \end{aligned}$$

$$\begin{aligned} AF &= \frac{5304.21}{8760.0} \times 100\% \\ &= 60.6\% \text{ (vs 3.0\% reported) } . \end{aligned}$$

Table 4 summarizes the outage data for Unit #4, a 665 MW(e) coal-fired unit. The availability factor for 1974 was calculated by the EEI computer program as

$$\begin{aligned} AH &= PH - FOH - POH - MH \\ &= 8760.0 - 2474.9 - 3353.8 - 579.9 \\ &= 2351.3 \\ AF &= \frac{2351.3}{8760.0} \times 100\% \\ &= 26.7\% \end{aligned}$$

but the footnotes to Table 4 point out that in tallying the outage hours, the EEI program failed to flag the following occurrences.

1. Forced outage #1 was reported as occurring during planned outage #14. The EEI program counted them both, biasing FOH by 2207.98 hours.
2. There is a forced outage labeled #1 and a maintenance outage #1 which occur at different times, contrary to reporting instructions since no two outages occurring at different times should have the same number.

Deleting the 2207.98 forced outage hours and correcting the availability factor gives

$$\begin{aligned} \text{AH} &= 8760.0 - 266.92 - 3353.81 - 579.94 \\ &= 4559.33 \end{aligned}$$

$$\begin{aligned} \text{AF} &= \frac{4559.33}{8760.0} \times 100\% \\ &= 52.0\% \text{ (vs 26.7\% reported) } . \end{aligned}$$

Utilities reporting to EEI often report outages incorrectly, i.e., not labeled according to the reporting instructions. The EEI computer programs which summarize individual outages to give annual totals and calculate annual performance factors lacks the capability to detect the reporting errors identified in this report. Thus, the annual availability factors, equivalent availability factors, and forced outage rates are systematically in error because all are calculated by summing outage hours. Availability factors and equivalent availability factors are systematically too low: forced outage rates are systematically too high.

The four unit-years of data investigated were selected because the relatively small number of outages reported made checking by hand calculation possible. It would be difficult to do this check for all the unit-year data and determine exactly the percentage of the data in error. However, a rough check shows that 20-25% of the unit-year data are obviously suspect because service hours exceed available hours, or capacity factor exceeds operating availability or equivalent availability. Presumably, another significant fraction of the data is in error but not enough to be obvious to the casual observer.

RECOMMENDATIONS

The National Electric Reliability Council (NERC) will assume custody of the EEI data bases and, beginning with the first quarter of 1979, will receive the utility outage reports. NERC should begin now to set up a comprehensive quality assurance program. Careful auditing of the outage data should identify the more obvious reporting errors. The data reduction and summary computer programs should be carefully programmed to identify and bypass obvious discrepancies. Resolution of these discrepancies

will require a large number of contacts with the reporting utilities. It is essential that NERC have sufficient manpower assigned to make these contacts and allow a timely update.

Table 1. Outages Reported for Unit #1 (a 525 MWe coal-fired unit) in 1974

1A. Forced Outage Hours (330.2 hours reported)

Outage No.	EEI cause code	Outage start		Outage end		Outage duration (hours)	Adjusted hours*
		Date	Time	Date	Time		
1	100	1/6	0618	1/7	0848	26.50	26.50
2	128	1/23	2028	1/23	2250	2.37	2.37
3	128	1/25	1421	1/25	1501	0.67	0.67
7	103	6/2	0018	6/3	2254	46.60	
8	100	6/4	0036	6/4	0259	2.38	
9	136	6/12	0239	6/14	0032	45.88	
10	700	6/12	0239	6/14	0032	45.88	45.88
13	110	7/24	0810	7/24	0851	0.68	0.68
15	110	7/26	1015	7/26	1055	0.67	0.67
17	904	8/25	0546	8/25	0649	1.05	1.05
18	100	9/24	1300	9/27	0355	62.92	62.92
19	699	10/24	0127	10/24	2306	21.65	21.65
20	199	11/14	1051	11/14	1851	8.00	8.00
21	199	11/21	1400	11/22	0010	10.17	10.17
22	612	11/30	1233	11/30	1433	2.00	2.00
23	612	12/7	1045	12/7	1214	1.48	1.48
24	101	12/17	2318	12/20	0211	50.88	50.88
25	612	12/20	0355	12/20	0422	0.45	0.45
Total						330.20	235.37

* Adjusted for errors found in this study.

Errors found: Outage #9 (10) is counted twice.

Outages #7, #8 occur during planned outage #10.

There is a forced outage #10 and a planned outage #10 which occur at different times.

Table 1. (Cont.): Outages Reported for Unit #1 in 1974

1B. Planned Outage Hours (3344.4 hours reported)

Outage No.	EEI Cause Code	Outage start		Outage end		Outage Duration (Hours)	Reported Hours*	Adjusted Hours**
		Date	Time	Date	Time			
4	151	3/13	0057	5/7	0600	1325.05	1325.05	1325.05
4	600	3/13	0057	5/4	2145	1268.80		
4	715	3/13	0057	5/4	2145	1268.80		
4	800	3/13	0057	5/4	2145	1268.80		
5	700	5/5	1108	5/6	0409	17.02	17.02	
6	600	5/6	2345	5/7	0600	6.25	6.25	
10	121	3/18	0800	6/4	0900	1873.00	1873.00	675.00
11	600	7/2	1943	7/6	0320	79.62	79.62	79.62
11	700	7/2	1943	7/6	0320	79.62		
12	700	7/10	0142	7/11	2108	43.43	43.43	43.43
Total							3344.40	2123.10

* Outages contributing to the total hours reported on the summary tape of EEI historical power plant performance data.

** Adjusted for errors found in this study.

Errors found: There is a forced outage #10 and a planned outage #10.
Outages #4, 5, 6, 10 overlap.

1C. Maintenance Hours (14.7 hours reported)

Outage No.	EEI Cause Code	Outage start		Outage end		Outage Duration (Hours)	Reported Hours*
		Date	Time	Date	Time		
14	100	7/25	1910	7/26	0951	14.68	14.68
18	600	9/24	1300	9/27	0355	62.92	
18	700	9/24	1300	9/27	0355	62.92	
Total							14.68

* Outages contributing to the total hours reported on the summary tape of EEI historical power plant performance data.

Available Hours (8760 - FOH - PH - MH)

Reported as $8760 - 330.2 - 3344.4 - 14.7 = 5070.7$

Leads to AF = $\frac{5070.7}{8760} = 57.9\%$

Table 2. Outages Reported for Unit #2 (an 810 MWe nuclear unit) in 1975

2A. Forced Outage Hours (1092.6 hours reported)

<u>Outage No.</u>	<u>EEL Cause Code</u>	<u>Outage start</u>		<u>Outage End</u>		<u>Outage Duration (Hours)</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>	
4	202	3/9	2359	3/23	1630	328.52
6	204	4/17	1630	4/26	0145	201.25
7	645	4/26	0325	4/26	0500	1.58
9	908	4/26	2042	4/27	2113	24.52
10	908	4/28	0456	4/30	0413	47.28
13	916	5/5	1047	5/5	1850	8.05
15	203	5/20	1830	5/21	1329	18.98
19	203	7/21	0050	7/24	1555	87.08
27	203	8/17	2042	8/26	2025	215.72
30	203	8/31	0325	9/5	2023	136.97
45	900	11/15	0321	11/15	1720	13.98
52	203	12/24	0440	12/24	1322	8.70
Total						1092.60

Errors found: Forced outage #4 coincides with maintenance outage #5.

2B. Planned Outage Hours (3102.6 hours reported)

<u>Outage No.</u>	<u>EEL Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Adjusted Hours*</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
1	210	1/1	0000	3/9	2359	1631.98	1631.98
2	600	1/8	0000	3/9	2359	1463.98	1463.98
8	207	4/26	1405	4/26	2042	6.62	6.62
Total						3102.60	1638.60

* Adjusted for errors found in this study.

Errors found: Outage #1 (2) is counted twice.

Table 2. (Cont.): Outages Reported for Unit #2 in 1975

2C. Maintenance Hours (1825.7 hours reported)

<u>Outage No.</u>	<u>EEI Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Adjusted Hours*</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
5	600	3/9	2359	3/23	1630	328.52	
"56"	600	3/23	1630	4/17	1630	600.00	600.00
23	299	8/15	0255	8/17	2003	65.13	65.13
41	209	10/3	2230	11/7	1434	832.07	832.07
Total						1825.70	1497.20

* Adjusted for errors found in this study.

Errors found: Outage #4 (5) is counted twice.

Available Hours (8760 - FOH - POH - MH)

Reported as $8760 - 1092.6 - 3102.6 - 1825.7 = 2739.1$

Leads to AF = $\frac{2739.1}{8760} = 31.3\%$

Table 3. Outages Reported for Unit #3 (a 665 MWe coal fired unit) in 1974

3A. Forced Outage Hours (320.6 hours reported)

Outage No.	EEI Cause Code	Outage start		Outage end		Outage Duration (Hours)	Adjusted Hours*
		Date	Time	Date	Time		
3	134	3/15	1329	3/15	1436	1.12	1.12
4	632	7/25	0535	7/27	0244	45.15	
5	622	7/25	0520	7/27	0244	45.40	45.40
6	622	7/28	1614	7/28	1923	3.15	3.15
7	632	8/5	0511	8/5	0557	0.77	0.77
7	712	8/27	1115	8/28	1252	25.62	
8	916	8/27	1115	8/28	1252	25.62	25.62
9	142	9/20	0513	9/20	0613	1.00	1.00
10	142	9/20	0513	9/20	0613	1.00	
11	143	9/20	0513	9/20	0613	1.00	
11	900	10/28	1315	11/2	0838	115.38	115.38
12	146	11/8	1516	11/9	1525	24.15	24.15
13	119	11/8	1516	11/9	1525	24.15	
13	632	11/15	1854	11/15	2259	4.08	4.08
14	146	11/26	2208	11/28	0024	26.27	26.27
14	632	11/15	1854	11/15	2259	4.08	
15	142	11/30	0212	11/30	0251	0.65	0.65
16	143	11/30	0212	11/30	0251	0.65	
17	142	12/31	1316	12/31	1358	0.70	0.70
18	143	12/31	1316	12/31	1358	0.70	
Total						350.64	248.29

* Adjusted for errors found in this study.

Errors found: There are forced outages #3, 4 and there are planned outages #3, 4 reported at different times.

Outage #4 (5) is counted twice.

There are two forced outages numbered 7 which occur at different times.

Outages (7,8), (9,10,11), (12,13), (13,14), (15,16) and (17,18) are reported more than once and were tallied incorrectly.

Table 3 (Cont.): Outage Data Reported for Unit #3 in 1974

3B. Planned Outage Hours (5549.6 hours reported)

<u>Outage No.</u>	<u>EEI Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Adjusted Hours*</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
3	600	3/30	0300	7/20	0718	2692.30	2692.30
4	507	3/30	0300	7/20	0715	2692.25	
8	100	9/6	2227	9/13	1932	165.08	165.08
Total						5549.63	2857.38

* Adjusted for errors found in this study.

Errors found: There are planned outages #3, 4 and there are forced outages #3, 4 reported at different times.

Outage #4 is the same as outage #3.

Outage #8 is the same as maintenance outage #9.

3C. Maintenance Hours (3151.6 hours reported)

<u>Outage No.</u>	<u>EEI Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Adjusted Hours*</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
1	900	2/8	2012	2/21	1700	308.80	308.80
9	930	9/6	2227	9/13	1932	165.08	
16	930	11/30	1836	12/2	1155	41.32	41.32
Total						515.20	350.12

* Adjusted for errors found in this study.

Errors found: Outage #9 is the same as planned outage #8.

The number of hours reported was 3151.6.

Available Hours (PH - FOH POH - MH)

Reported as $8760 - 320.6 - 5549.6 - 3151.6 = -261.8$

Leads to AF = $-\frac{261.8}{8760} = -3\%$ (3% reported).

Table 4. Outages Reported for Unit #4 (a 665 MWe coal fired unit) in 1974

4A. Forced Outage Hours (2474.9 hours reported)

<u>Outage No.</u>	<u>EEI Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Adjusted Hours*</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
1	100	7/1	0000	9/30	2359	2207.98	
2	142	2/18	0510	2/18	0615	1.08	1.08
3	622	2/18	1408	2/18	1552	1.73	1.73
4	142	2/19	0221	2/19	0258	0.62	0.62
5	142	2/28	0042	2/28	0146	1.07	1.07
6	142	2/28	0300	2/28	0652	3.87	3.87
7	142	3/4	1652	3/4	2044	3.87	3.87
8	134	3/15	0221	3/15	0329	1.13	1.13
9	134	3/15	0352	3/15	0457	1.08	1.08
11	622	4/1	0111	4/1	1547	14.60	14.60
12	121	4/11	0106	4/13	1122	58.27	58.27
13	900	4/18	1740	4/19	1953	26.22	26.22
15	919	10/8	1510	10/9	0533	14.38	14.38
16	134	10/15	1533	10/15	1742	2.15	2.15
17	103	10/23	0543	10/28	1824	132.68	132.68
18	134	11/4	1322	11/4	1732	4.17	4.17
18	910	11/4	1322	11/4	1732	(4.17)	
Total						2479.07	266.92

* Adjusted for errors found in this study.

Errors found: Outage #1 occurs during planned outage #14.

There is a forced outage #1 and a maintenance outage #1 reported at different times.

Table 4. (Cont.): Outages Reported for Unit #4 in 1974

4B. Planned Outage Hours (3353.8 hours reported)

<u>Outage No.</u>	<u>EEl Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Hours Reported</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
14	100	5/22	0219	10/6	1036	3296.28	3296.28
14	542	5/22	0219	10/6	1036	3296.28	
14	600	5/22	0219	7/31	2400	1701.68	
19	802	11/21	2347	11/24	0919	57.53	57.53
Total							3353.81

4C. Maintenance Hours (579.9 hours reported)

<u>Outage No.</u>	<u>EEl Cause Code</u>	<u>Outage start</u>		<u>Outage end</u>		<u>Outage Duration (Hours)</u>	<u>Hours Reported</u>
		<u>Date</u>	<u>Time</u>	<u>Date</u>	<u>Time</u>		
1	900	1/25	2032	2/8	1213	327.68	327.68
10	900	3/21	2043	3/28	1945	167.03	167.03
19	901	11/21	2347	11/24	919	57.53	
20	104	12/26	1434	12/30	0348	85.23	85.23
Total							579.94

Errors found: There is a maintenance outage #1 and a forced outage #1 reported at different times.

Available Hours (PH - FOH - POH - MH)

Reported as $8760 - 2474.9 - 3353.8 - 579.9 = 2351.3$

Leads to AF = $\frac{2351.3}{8760} = 26.7\%$

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