

NYISO ICAP MANUAL
Attachment J

Implementation of Unforced Capacity for ICAP Supplier Qualifications

TABLE OF CONTENTS

SECTION	PAGE
I SCOPE OF RESPONSIBILITY	1
II ACRONYMS	12
III DEFINITIONS AND	2
III. EQUATIONS	
1. Equivalent Outage Hours.....	3
2. Equivalent Demand Forced Outage Rate.....	3
3. Equivalent Forced Outage Factor.....	4
4. Equivalent Maintenance Outage Factor.....	4
5. Equivalent Planned Outage Factor	4
6. Equivalent Availability Factor	4
7. Effective Equivalent Demand Forced Outage Rate	4
8. Equivalent Scheduled Outage Factor	4
7. Full and 9. Full and Partial f-Factors.....	4
10. Forced Outage Hour Adjustment for a Unit Partially on Deferred Maintenance	7
IV PERIODIC REPORTS	
Introduction.....	8
Preliminary Supplemental Agreement Outage Data Report.....	9
Supplemental Agreement Outage Data Report	10
Planning Study Outage Data Report	20
Adequacy & Reliability Assessment Report	27
V MISCELLANEOUS DOCUMENTATION	
A. Derivation of f-Factors.....	29
B. Modified Two-State Model for Reliability Calculations	32
BC. Rules for Consistency of Generator Outage Rate Calculations <u>[under review by NYISO staff]</u>	
D. Deferred Maintenance Forced Outage Adjustment Calculation Guidelines	
E. Variance Calculation Procedure for Existing Units	
CF. GUS Programs Introduction <u>[under review by NYISO staff]</u>	
1. Generator Outage Rate Program (GORP)	
2. Average Company EFOR Program	

~~VI — FIGURES~~

~~F1 — Sample Preliminary Supplemental Agreement Outage Data Report~~

~~F2 — Sample Supplemental Agreement Outage Data Report~~

~~F3 — Sample Planning Study Outage Data Report~~

~~F4 — Sample Table III Rates for Combined Cycle Conversions of Existing CTs~~

~~F5 — Sample Adequacy & Reliability Assessment Tables~~

Section I
Scope of Responsibility

~~PJM PLANNING AND ENGINEERING COMMITTEE(*)~~
~~GENERATOR UNAVAILABILITY SUBCOMMITTEE~~
SCOPE OF RESPONSIBILITY

~~The PJM Generator Unavailability Subcommittee (GUS) is responsible to the PJM Planning and Engineering Committee (P&E) in all matters concerning the projection of generating unit unavailabilities, as required for PJM Reliability and Capacity Allocation studies. The Subcommittee shall also be responsible for other data required for specific planning applications.~~

~~To execute this charge, the Subcommittee shall develop and maintain unavailability rate definitions consistent with the purposes defined above. The Subcommittee shall also monitor and assess industry outage trends and tools to determine their utilization for PJM applications.~~

~~The Subcommittee is responsible for the preparation of two documents titled "Forced Outage Rates and Unavailable Capacity Due to Planned and Maintenance Outages for the PJM Supplemental Agreement" and "Forced Outage Rates and Scheduled Outage Data for Planning Studies." These documents provide data for Capacity Allocation and Reserve Requirement studies.~~

~~The Subcommittee shall also maintain, but will not be limited to, the PJM Generator Outage Rate Program (GORP) for historical data analysis.~~

~~Specific activities include:~~

- ~~Update the "Report on Generating Unit Outage Definitions – Appendix B", as required.~~
- ~~Update, annually, "Forced Outage Rates and Unavailable Capacity Due to Planned and Maintenance Outages for the PJM Supplemental Agreement" and "Forced Outage Rates and Scheduled Outage Data for Planning Studies."~~
- ~~Provide projections of class average outage rates for new units.~~
- ~~Monitor the industry for general trends and outage rate calculation tools.~~
- ~~Provide miscellaneous reports and statistics required by other Committees/Subcommittees, e.g. "Production Cost Study Outage Rate Report."~~
- ~~Recommend refinements in PJM outage data collection procedures, as required.~~
- ~~Maintain the Generator Outage Rate Program for historical data analysis, and expand, as necessary, to fit other applications.~~

(*) Excerpted from the November 28, 1978 letter to the Management Committee from S.C. Thomas, P&E Committee chairman, which transmitted revised Scopes of Responsibilities for all P&E committees.

Section II
Section I
Acronyms

C&TPS	-	PJM Capacity and Transmission Planning Subcommittee
EEI	-	Edison Electric Institute
GADS	-	Generating Availability Data System
GADS		
GCRPTF	-	PJM Generating Capability Rating Procedures Task Force
GEBGE	-	General Electric, Baltimore Gas & Electric Reliability Program
GORP	-	Generator Outage Rate Program
GUS	-	PJM Generator Unavailability Subcommittee
GUSOUT	-	Synonym for GORP
IEEE	-	Institute of Electrical and Electronic Engineers
L&CWG	-	PJM Load and Capacity Working Group
MC	-	PJM Management Committee
NERC	-	North American Electric Reliability Council
OC	-	PJM Operating Committee
PCTF	-	PJM Production Cost Task Force
P&E	-	PJM Planning and Engineering Committee
RMTF	-	PJM Reliability Methods Task Force
SRTF	-	PJM System Reliability Task Force
		<u>[Question: add NY references as above?]</u>

FOR	-	Forced Outage Rate
EFOR _D	-	Equivalent Demand Forced Outage Rate
EEFOR_D	-	Effective Equivalent Demand Forced Outage Rate
EFOF	-	Equivalent Forced Outage Factor
MOF	-	Maintenance Outage Factor
EMOF	-	Equivalent Maintenance Outage Factor
POF	-	Planned Outage Factor
EPOF	-	Equivalent Planned Outage Factor
SOF	-	Scheduled Outage Factor
OAF	-	Operating Availability Factor
EAF	-	Equivalent Availability Factor

AH	-	Available Hours
FOH	-	Full Forced Outage Hours
FPOH	-	Forced Partial Outage Hours
EFOH	-	Equivalent Full Forced Outage Hours
EFPOH	-	Equivalent Forced Partial Outage Hours
MOH	-	Full Maintenance Outage Hours

- MPOH - Maintenance Partial Outage Hours
- EMOH - Equivalent Full Maintenance Outage Hours
- EMPOH - Equivalent Maintenance Partial Outage Hours
- PH - Period Hours
- POH - Full Planned Outage Hours
- PPOH - Planned Partial Outage Hours
- EPOH - Equivalent Full Planned Outage Hours
- EPPOH - Equivalent Planned Partial Outage Hours
- EPOEF - Equivalent Planned Outage Extension Factor
- RSH - Reserve Shutdown Hours
- SH - Service Hours
- UOH - Unplanned Outage Hours

- f_p - partial f-factor
- f_f - full f-factor

Section III **Definitions and Equations**

Definitions

Forced Outage:

An outage that cannot be postponed beyond the end of the next weekend, due to equipment failure, environmental (emissions) limitations, or, in the case of run-of-rive hydro generation, lack of water.

Maintenance Outage:

An outage that can be postponed beyond the end of the next weekend, but requires the unit be removed before the next planned outage.

Planned Outage:

An outage of predetermined length that is scheduled in accordance with the procedures contained in Section 4.3 of the NYISO ICAP Manual. ~~well in advance of its occurrence. The outage must be included in a regularly issued maintenance schedule at least one month prior to the starting date of the outage; i.e., the outage must appear in two consecutive issues of the PJM Unit Maintenance Schedule prior to starting the outage.~~

Non-curtailing Outage:

~~The removal from service of spare or redundant equipment (i.e., major components or entire systems) for repairs which causes no unit outage or capacity reduction.~~

Postponability Code 9 Off-Peak Outage:

A routine, periodic outage (e.g., deslagging, condenser cleaning, etc.) which both starts and ends during a single ~~valley load~~ off-peak period (i.e., the time period from 22:00:01 to 08:00:00, inclusive).

Deferred Maintenance:

~~The classification of forced outage time (full or partial) for a unit with repairs deferred for at least 90 days due solely to company financial constraints.~~

Period Hours:

The total clock time in the period of concern.

Service Hours:

The time a unit is electrically connected to the system.

Reserve Shutdown Hours:

The time a unit is available for service but not dispatched by the NYISO or the relevant local control center due to economics or other reasons. ICAP Suppliers are not allowed to self-declare Reserve Shutdown status.

Available Hours:

The time a unit is capable of producing energy, regardless of its capacity level.

Demand Hours:

The time interval each day on a particular system in which there is a heavy demand for electricity. For ~~the NYCAPJM~~, it is the time period beginning 87:00:01 and ending 22:00:00, inclusive.

Equivalent Outage Hours:

The number of hours a unit was involved in an outage, expressed as equivalent hours of full outage at its maximum net dependable capacity. Equivalent hours can be calculated for forced, maintenance, or planned outages. Overlapping partial outage hours are not permitted in ~~NY PJM~~ outage rate calculations and overlaps are eliminated according to an outage type hierarchy.

[Note: this definition needs further refinement.] (Refer to Equation 1, page 5.)

Equivalent Demand Forced Outage Rate:

The portion of time a unit is in demand, but is unavailable due to a forced outage. (Refer to Equation 2, page 5.)

Equivalent Forced Outage Factor:

The portion of time a unit is unavailable due to forced outages. (Refer to Equation 3, page 5)

EPOEF:

The ratio of EPOF (with SE's included) to EPOF (with SE's excluded). SE stands for maintenance schedule extension. This factor will not be used on startup. [Does this mean for the 2000 data calculations? Beyond?]

Equivalent Maintenance Outage Factor:

The portion of time a unit is unavailable due to maintenance outages. (Refer to Equation 4, page 5.)

Equivalent Planned Outage Factor:

The portion of time a unit is unavailable due to planned outages. (Refer to Equation 5, page 6.)

Operating Availability Factor:

~~T~~The portion of time a unit is available to operate, based on forced outages only.

Equivalent Availability Factor:

The portion of time a unit is available to operate, recognizing equivalent partial outage time. (Refer to Equation 7, page 6.)

Effective Equivalent Demand Forced Outage Rate:

~~The forced outage rate used for reliability and reserve margin calculations. (Refer to Equation 8, page 6.)~~

Equivalent Scheduled Outage Factor:

~~The planned outage rate used for reliability and reserve margin calculations. (Refer to Equation 9, page 6.)~~

Variance:

~~A measure of the variability of a unit's partial forced outages which is used in reserve margin calculations. (Refer to Section V, Item E, page 35.)~~

f-factor:

Factors which have been adopted by PJM to scale the total number of forced outage hours to reflect those which occur during demand hours. Separate factors exist to adjust full (f_f) and partial (f_p) outage hours. (Refer to Equation 10, page 6.)

Planning Period:

The continuous time period beginning 00:00:01 on ~~June 1~~ May 1 of a given year and ending 24:00:00 on ~~May 31~~ April 30 of the following year.

Mature Unit:

~~A unit having at least three full calendar years of operating experience for Supplemental Agreement usage or at least five full calendar years of operating experience for reliability calculations.~~

Immature Unit: [May keep this term but use a combination of GADS data & NERC class average data for immature units.]

~~A unit having between zero and three full calendar years of operating experience for Supplemental Agreement usage or between zero and five full calendar years of operating experience for reliability calculations.~~

Future Unit:

~~A unit to be placed in service at some future time, as indicated in a forecast installed capacity schedule.~~

Inactive Status:

~~The classification of a unit which is unavailable for an extended period of time because of its removal from service for economic or non-equipment related reasons.~~

Mothballed Unit:

~~A unit placed on inactive status.~~

Section III

Equations

1. Equivalent Outage Hours:

The following equation is applicable to forced, maintenance and planned capacity derations.

$$E = \sum_i \left(\frac{D_i * T_i}{C_i} \right)$$

where E = equivalent outage hours,

D_i = capacity deration for outage i, MW,

T_i = time accumulated during outage i, hours, and

C_i = unit maximum net dependable capacity at the time of this outage, MW.

NOTE: The capacity can change if the outage extends over 1 or more months.

2. Equivalent Demand Forced Outage Rate:

$$EFOR_D(\%) = \frac{f_f * FOH + f_p * EFPOH}{SH + f_f * FOH} * 100\% \quad \text{Note: } \underline{EFPOH = EFPH - FOH}$$

3. Equivalent Forced Outage Factor:

$$EFOF(\%) = \frac{EFOH}{PH} * 100\% = \frac{FOH + EFPOH}{PH} * 100\%$$

Or

$$EFOF(\text{weeks / year}) = \frac{EFOH}{PH} * \frac{PH}{n * 168}$$

where n is the number of years of accumulated outage hours.

4. Equivalent Maintenance Outage

$$EMOF(\%) = \frac{EMOH}{PH} * 100\% = \frac{MOH + EMPOH}{PH} * 100\%$$

Note: EMPOH=EMOH-MOH

Or

$$EMOF(\text{weeks / year}) = \frac{EMOH}{PH} * \frac{PH}{n * 168}$$

where n is the number of years of accumulated outage hours.

5. Equivalent Planned Outage Factor:

$$EPOF(\%) = \frac{EPOH}{PH} * 100\% = \frac{POH + EPPOH}{PH} * 100\%$$

or

$$EPOF(\text{weeks} / \text{year}) = \frac{EPOH}{PH} * \frac{PH}{n * 168}$$

where n is the number of years of accumulated outage hours.

6. Equivalent Planned Outage Extension Factor:

$$EPOEF = \frac{EPOF(w / SE_{included})}{EPOF(w / SE_{excluded})}$$

7. Equivalent Availability Factor:

$$EAF(\%) = \frac{AH - (EFPOH + EMPOH + EPPOH)}{PH} * 100\%$$

8. Effective Equivalent Demand Forced Outage Rate:⁽¹⁾

$$EEFOR_D(\%) = EFOR_D(\%) + 1 / 4 * EMOF(\%)$$

9. Equivalent Scheduled Outage Factor:¹

The equivalent scheduled outage factor can be expressed in either % or weeks/year using the equation

$$ESOF = EPOF + 3 / 4 * EMOF$$

¹Since GEBGE can only accommodate two outage rates, the maintenance outage factor must be allocated to one, or both, of these rates. A rationale for proportioning it as shown is contained in the document "Report on the Study of Load Models and Reliability Program Features," Section I - GEBGE Options, pages 5-7 (Random Maintenance), issued March, 1972 by the PJM Capacity and Transmission Planning Subcommittee. The original decision, presumably made by the PJM Planning and Engineering Committee, predates the indicated report.

10. **f-factors:**^{2, 3}

$$f_f = \frac{1/r + 1/T}{1/r + 1/T + 1/D}$$

where r = average forced outage duration

$$= \frac{\text{FOH}}{\text{number of forced outages}}$$

T = average time between calls for a unit to run

$$= \frac{\text{RSH}}{\text{number of attempted starts}}$$

D = average run time

$$= \frac{\text{RSH}}{\text{number of successful starts}}$$

and

² The full f-factor was adopted for use by PJM with the acceptance of the "Report on Generating Unit Outage Definitions" issued in November, 1972 by the PJM Operating and P&E Committees. Refer to Section V, Item A, page 25 for the derivation of the full f-factor.

³ The current definition of the partial f-factor was proposed by the Generator Unavailability Subcommittee, and approved for use by the Planning and Engineering Committee at its 260th meeting held March 8, 1982.