Definition. Available Transfer Capacity (ATC) is the maximum amount of additional[1] MW transfer that is possible between two parts of a power system[2]. ATC is the point where power system reliability constrains electricity market efficiency, so it has a huge impact on market outcomes and system reliability.

Method. The two quantities underpinning the calculation are:

1. Outage Transfer Distribution Factor (OTDF), which is the fraction of a transfer that will flow on a branch *m* after a contingency[3] *c* occurs.
2. Outage Flow ("OMW"), which is the flow on a branch *m* after a contingency *c* occurs.

The corresponding formulae for a multiple line outage (contingent lines 1 … *n*) are:

$$\Psi_{m,c} = \psi_m + \sum_{k=1}^{n} \lambda_{m,k}\,\hat{\psi}_k$$

$$\mathrm{F}_{m,c} = f_m + \sum_{k=1}^{n} \lambda_{m,k}\,\hat{f}_k$$

Where Ψ stands for OTDF; ψ, for PTDF[4]; λ, for LODF; $\hat{\psi}$, for "net PTDF"; F, for OMW; *f*, for pre-outage flow; and $\hat{f}$, for "net flow". The formulae needed to calculate the transfer limiting value τ[5] for each branch whose flow limit is $\mathcal{F}$, without and with contingencies, are as follows:

$$\tau_m = \begin{cases} \dfrac{\mathcal{F}_m - f_m}{\psi_m}, & \psi_m > 0 \\ \infty, & \psi_m = 0 \\ \dfrac{-\mathcal{F}_m - f_m}{\psi_m}, & \psi_m < 0 \end{cases}$$

$$\tau_{m,c} = \begin{cases} \dfrac{\mathcal{F}_m - \hat{f}_m}{\Psi_m}, & \Psi_m > 0 \\ \infty, & \Psi_m = 0 \\ \dfrac{-\mathcal{F}_m - \hat{f}_m}{\Psi_m}, & \Psi_m < 0 \end{cases}$$

The ATC for the node of interest is the minimum of τ_m or $\tau_{m,c}$ for all branches and contingencies. As defined above, the ATC quantifies the *additional generation* that the node can host. The corresponding formulae to quantify the *additional load* that the node can bear are as follows:

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[1] Additional acknowledges that existing transfers are accounted for in the base case.
[2] Typically, they correspond to different control areas.
[3] The contingency may correspond to the outage of one or more transmission elements—i.e., a transformer, a transmission line segment, or a generator.
[4] We use a compact notation—e.g., ψ_m is short for $\psi_{i,j,m}$, where the subscripts *i* and *j* are the indices for the sending and receiving nodes, respectively. In the ATC context, the sending node is typically the interconnection candidate whose ATC is sought.
[5] With respect to the node of interest.

$$\tau_m = \begin{cases} \dfrac{f_m + \mathcal{F}_m}{\psi_m}, & \psi_m > 0 \\ \infty, & \psi_m = 0 \\ \dfrac{f_m - \mathcal{F}_m}{\psi_m}, & \psi_m < 0 \end{cases}$$

$$\tau_{m,c} = \begin{cases} \dfrac{\hat{f}_m + \mathcal{F}_m}{\Psi_m}, & \Psi_m > 0 \\ \infty, & \Psi_m = 0 \\ \dfrac{\hat{f}_m - \mathcal{F}_m}{\Psi_m}, & \Psi_m < 0 \end{cases}$$

Caveat. Flow sensitivities to power transfer are only accurate around the underlying power flow solution—therefore, control changes (e.g., to phase shifters) as the system is ramped to the transfer limit are not captured.

Reference. Wood, A. J., Wollenberg, B. F., Sheblé, G. B. (2013). *Power Generation, Operation, and Control*. Wiley.