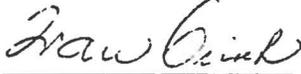


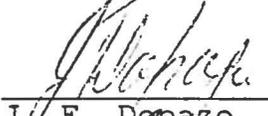
Energy Costing and Reporting  
Reconstruction Documentation

Date: January 1981

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ENERGY COSTING & REPORTING  
RECONSTRUCTION

Introduction

The reconstruction documentation describes in detail the logic used by the ECR system in the computation of costs of energy.

Throughout the documentation reference is made to generation levels such as hourly normal low generation level, actual generation level, etc. Since the ECR system deals with energy, all references to generation denote a specific constant generating level integrated over a period of 1 hour. Therefore, a reference to an amount of energy equal to the hourly normal low generation level of a unit, should be interpreted to mean an amount of energy equal to the amount of energy that the unit would have generated had it been operating at its hourly normal low level for a period of 1 hour.

It should be noted, that although the actual generating levels integrated over 1 hour are used as the starting point, any reference made in this documentation to changes in generation levels is in response to a 'what if' situation. All manipulation of sources, generating levels etc. are purely hypothetical and have no implication as to the actual generating levels, capabilities, etc. of the units.

## Reconstruction Overview

The purpose of the Reconstruction Component of the ECR System is to reconstruct the allocation of sources of energy to system delivery transactions which was done initially in real time either directly or by the economic dispatch system. The allocation of energy is performed for each hour using unit generation integrated over the hour and purchased energy as sources. Secondly, the purpose of the Reconstruction Component is to determine the cost incurred by the AEP system in connection with each system delivery transaction for the hour.

All purchases and units are potential sources for allocation of energy to delivery transactions. Units will be excluded from the potential sources if they are base loaded or hydro units. This exclusion is performed automatically according to unit characteristics stored within the ECR files.

Explicit exclusion of a source from the configuration of potential sources of energy for allocation to delivery transaction(s) may also be specified by SPPC at their discretion.

The allocation of sources of energy to delivery transaction(s) will be performed as a combination of direct allocation explicitly specified at the discretion of SPPC and incremental

allocation as determined by economic dispatch algorithms. The purpose of both direct and incremental allocation of sources of energy is to determine the cost to the AEP system of the delivery transaction(s) for the hour.

Incremental allocation of sources is performed by simulation of the 'generating' system operation controlled by the real-time economic dispatch. Simulations of the 'generating' system for system loads with and without the delivery transaction(s) are performed. The difference between the two simulations is then used to compute the cost to AEP of the sources incrementally allocated.

Note: 'Generating' system refers to the system configuration of generating units and purchases, i.e. all sources. The simulation of the 'generating' system operation at a specific system load establishes 'generation' levels for sources according to the following criteria:-

- a) The sum of generation levels for all sources must equal the system load (with allowance for losses).
- b) All sources available for the allocation of energy to the delivery must be at 'generating' levels such that the incremental cost of energy for each source is identical after the delivery transaction has been subtracted from the system load. Exceptions to this criteria are those sources which are

at their maximum or minimum operating level after subtraction of the delivery transaction from the system load.

The incremental cost of energy for a unit at a particular generating level is determined from the generation cost curve applicable to the unit. A generation cost curve is defined by a quadratic equation whose coefficients are computed by the Reconstruction from the Heat Rate (or Input/Output) Curve equation coefficients and applicable costs (fuel, maintenance etc).

The limits of applicability of the generation cost curve are usually the normal low generation level to the normal high generation level of the unit. Within these limits, the incremental cost of energy increases as the 'generation' level increases from the normal low generation level.

In order to perform the simulation, purchases and pumped-hydro units are modeled as normal units i.e. assigned generation cost curve coefficients. A constraint in the incremental allocation of unit energy is the lower limit of the generation cost curve. This lower limit is usually the hourly normal low generation level of the unit. The energy below this limit cannot normally be allocated incrementally because the existing generation cost curve is not applicable and no other applicable curve has been established.

However, the average cost of energy generated by the unit when it is operating at its normal low generation level is high relative to the incremental cost at generation levels above the normal low.

In order to allocate the high-cost energy below the normal low generating level of a unit, direct allocation is performed. Direct allocation assigns the energy and associated costs from a unit to the specified delivery transaction(s). Direct allocation of unit energy is performed at the discretion of SPPC when it is determined that in the absence of specific delivery transaction(s), specific unit generation would not have been necessary.

Direct allocation of purchased energy is also performed at the discretion of SPPC. However, since purchased energy is not subject to the constraint of operating levels the scenario for direct allocation differs. Purchased energy is directly allocated to delivery transaction(s) when AEP is the transmitting party of a 3-way transaction. The supplier of the purchased energy and the receiver of the delivered energy are party to the 3-way transaction. Purchased energy may also be directly allocated to delivery transactions at the discretion of SPPC. In this case, the purchase may have been made to supply energy for the delivery transaction.

Delivery transactions may be processed for the allocation of sources individually or as members of groups. In order to simulate the effect of a transaction or group or operation of the AEP 'generating' system, each group or transaction is assigned a number. The assigned sequence number denotes the relative order by which the transactions would have been added to the AEP system internal load. In the Reconstruction, the 'generating' system is unloaded. Unloading is performed by allocating the required sources of energy to each transaction or group in descending order of sequence number. The starting point for unloading in any hour, is the actual 'generation' levels of sources (units and purchases).

The sum of the 'generation' levels of all sources after all system obligation deliveries have been processed, is the firm load of the AEP system.

## 1. Direct Allocation of Sources to Transactions

In order to reconstruct a delivery transaction, sources of energy may be directly or incrementally allocated to the delivery. Incremental allocations are made on an incremental cost basis by the economic dispatch routine during the Reconstruction processing. (See Section 3).

Direct allocation of energy from a source to a delivery transaction is performed at the discretion of SPPC and the allocation specification is input to the Reconstruction. The source I.D. and the maximum amount of energy to be allocated directly together with the delivery transaction I.D., form the specification.

In addition to direct allocations of energy, SPPC may directly allocate a dollar charge to a delivery transaction. This charge allocation is also specified in the input to the Reconstruction.

### 1.1 Allocation of Generating Units

#### 1.1.1 Energy Allocation

The purpose of direct allocation of unit energy to a delivery transaction is to ensure that all costs incurred by AEP because of the transaction(s) are recovered. Unit energy is

normally directly allocated to a delivery transaction(s) if the specified unit is included in the AEP generating system only to supply energy to the transaction(s). (I.e. the unit generation was not required to meet internal system load or other delivery transaction requirements).

Under normal system operating conditions, no generating unit may sustain a generation level below its normal low. In incremental allocation processing, the energy allocations to a delivery are made on the basis of 'what if' the delivery had not taken place. The heat requirements of a generating unit at a generation level between its normal high and low levels are defined by the unit heat rate curve. The quadratic equation of this curve together with fuel costs are used for incremental allocation of energy (see Section 3.3). No corresponding curve has been established for unit heat requirement at generating levels below the normal low. The normal low generating level of a unit therefore forms the lower constraint for incremental allocation under normal conditions.

However, the average energy cost in \$/MWH of a unit operating at its normal low generation level is frequently high relative to the incremental energy costs at generation levels above the normal low. Therefore inclusion of the unit energy generated below the normal low of the unit, in the generation required to meet the AEP Internal load may impose a financial

burden on AEP 'Internal' customers. This energy must therefore be allocated to the transaction(s) which caused the unit to be added to the AEP system configuration.

The purpose of direct allocation is therefore to allocate to a delivery, the energy and associated costs that cannot be allocated incrementally but were incurred because of the delivery, namely the energy generation below the normal low.

The maximum amount of energy to be directly allocated to delivery transaction(s) may be specified by SPPC as follows:-

- a) An amount equal to the hourly normal low generation of the unit (default when no amount specification given).
- b) The total generation of the unit for the hour.
- c) A specified (input) amount. (The range for this amount is  $0 < \text{amount} < \text{total generation of the unit}$ ).
- d) A percentage of a), b) or c).

The amounts specified by SPPC are the maximum amounts of unit energy that will be allocated directly to the specified delivery transaction(s) by the Reconstruction.

The direct allocation of energy to delivery transaction(s) is processed immediately prior to any incremental allocation

of energy to the same delivery. Since the allocation of energy to other transactions may have already been processed as determined by the sequence number (see section 3.1), the amount of unit energy still available may be less than that specified for direct allocation. (This will normally only occur if the specified allocation amount was larger than the hourly low). The amount of energy directly allocated is therefore the amount of unit energy available up to the specified amount. For details of direct energy allocation processing, see Section 3.3.

#### 1.1.2 Surcharge Allocation

An example of a surcharge occurrence is the start-up cost payable by a receiving company when the start-up is the direct result of the cancellation by the receiving company of a transaction to which energy from that unit was directly allocated. This situation can occur when back-to-back transactions specify energy from the same unit to be directly allocated and the first of the two transactions is cancelled prior to completion forcing a shut-down of the unit on economic grounds.

Cost incurred by unit may be allocated to a transaction or group of transactions as a surcharge as follows: -

- a) a specified dollar amount
- b) a percentage of a specified dollar amount

If a \$ amount is specified by SPPC it is assumed to be surcharged to the specified transaction or group and added to the specified unit costs. The amount is a unit surcharge and does not affect any start-up, minimum credit or energy charges applicable to the unit and hour or the manner in which these charges are allocated. The surcharge may be a debit or credit (i.e. if a negative amount is specified the result will be a credit to the transaction).

If the specified transaction is a member of a group (i.e. there exists more than 1 transaction for a given sequence number for the hour), the surcharge is divided amongst group members according to the scheduled amount of energy delivery to each number for the hour.

If the unit is a jointly owned unit, the surcharge to each group member is divided amongst the unit owners in proportion to their percentage ownership.

There is no tax applicable to the surcharge.

If a \$ amount and percentage are specified by SPPC it is assumed that the given percentage of the specified amount in

dollars is to be surcharged to the specified transaction or group and this amount is to be added to the specified unit costs. This surcharge is processed in an identical manner to the same surcharge without a specified percentage, (i.e. as in a.) except that the surcharge amount is the product of the \$ amount and percentage entries.

## 1.2 Other Source Allocation

Sources of energy other than AEP generating units are referred to in this section as 'other sources'. The term 'fixed rate sources' is also used but may include AEP generating units such as Smith Mountain which do not adhere to the normal generation cost curve characteristics. For description of special unit handling see section 5. Other sources are normally purchased power or interchange-in transactions. Purchased energy or purchase will be used to denote a source from either.

### 1.2.1 Allocation of Purchased energy

Purchased energy will be directly allocated to delivery transaction(s) at the discretion of SPPC. Purchased energy is normally directly allocated to delivery transaction(s) if the purchase transaction was made in order to supply energy for the delivery transaction(s).

a) Energy Transmitted by AEP

If the purchase and delivery transactions were actually part of a 3-way transaction and AEP is the transmitting party, SPPC so specifies on the input to the Reconstruction. The purpose of a separate designation for transmitted energy as opposed to supplied energy is to ensure that the appropriate rate is used in the computation of the billing in the Intercompany Settlement Component of the ECR system.

In the case of a transmission, all energy for the delivery transaction except losses is supplied by directly allocated purchased energy.

If SPPC specifies via the input to the Reconstruction that losses are to be excluded:-

- No calculation of transmission losses is made by the Reconstruction.
- Both the purchased and delivered energy are removed from the system prior to source allocation processing (see Section 3). (If only a portion of the energy supplied by the specified purchase transaction(s) was required by the delivery transaction(s), the remaining energy is included in the system for source allocation processing).

- An allowance for the cost of losses is normally made in the rate structure.

If SPPC specifies via the input to the Reconstruction that losses are to be included:-

- Losses are calculated and sources are allocated for losses as part of normal source allocation processing (see Section 3).
- The purchased energy allocated to the delivery transaction is included in the system for source allocation processing but is held in reserve for the delivery transaction(s). (If only a portion of the energy supplied by the specified purchase transaction(s) was required by the delivery transaction(s), the remaining energy is included in the system on an unreserved basis for source allocation processing).

b) Energy Supplied by AEP

Unless a transmission is specified by SPPC on the input to the Reconstruction, all delivery transactions are assumed to be for energy supplied by AEP.

Purchased energy may be directly allocated to delivery transaction of supplied energy in a manner similar to

the direct allocation of generated energy to these transactions. The direct allocation of purchased energy to delivery transactions is made at the discretion of SPPC and specified in the input to the Reconstruction.

The purpose of direct allocation of purchased energy to delivery transaction(s) is to ensure that the cost of purchased energy is passed on to the delivery transaction(s) which necessitated the purchase. Since purchased energy is not subject to the physical constraint of normal low generation as unit energy, all purchased energy is available for incremental allocation during source allocation processing.

#### 1.2.2 Curtailment Cost Allocation

Costs associated with the curtailment of a delivery transaction in order to supply another delivery transaction may be allocated to the uncurtailed delivery. Normally, an economy delivery is curtailed in order to supply an emergency delivery. In this case, the source specified by SPPC is the curtailed delivery transaction. An amount of energy in MWH may also be specified by SPPC.

If no MWH value is specified, it is assumed that the entire delivery was made on the basis of a curtailment and the

amount of curtailment is therefore equal to the entire delivery in the hour.

If an MWH value is specified, the entry is used as the amount of energy curtailed.

If a percentage entry is made the curtailment energy amount is adjusted by the percentage specified.

The curtailment cost is computed as follows: -

cost = curtailment MWH\*P\* (AEP quoted - foreign company rate)

where P = .500 for block no = 0,1,2 (normal economy)

P = .425 for block no = 3,4 (3-way economy)

Since curtailments of economy transactions are AEP system (MLR) obligations, the cost is divided according to the current MLR and credited to the pool members accordingly, within the Reconstruction.

## 2. Incremental Allocation of Sources To Transactions

### 2.1 Unit Availability

During the incremental allocation of energy to a transaction, the system configuration is made up of two types of units plus purchases. The unit types are a) available for incremental allocation and b) not available for incremental allocation but included for system loss calculation purposes.

All units can be available for incremental allocation of energy to a transaction. Units are initially available by default and are subsequently made unavailable according to the following criteria: -

- i) The active/inactive code for the unit stored in the ECR Company/Unit file indicates that the unit is inactive or not available for incremental allocation.

Inactive units, e.g. Twin Branch; are excluded from the system configuration.

Base loaded units, are included in the system configuration for loss calculation only, because the active/inactive code indicates the unit is never

available for incremental allocation. Other units which are never available are the hydro units. These rules apply to all hours.

- ii) A unit will be made unavailable for further incremental allocation of energy to remaining delivery transactions for the hour if its normal low generation level for the hour has been reached (see section 4.2 for low load condition exception).
  
- iii) A unit will be made unavailable for incremental allocation of energy to a specific delivery transaction or group if source allocation data input specifically restricts this unit for any transaction in the group.

The unit will be in available status both before and after the specified transaction or group has been incrementally processed unless other criteria prevail.

## 2.2 Other Source Availability

Sources of energy other than AEP generating units are referred to in this system as 'other sources'. The term 'fixed rate sources' is also used but may include AEP generating units such as Smith Mountain which do not adhere to the normal generation cost curve characteristics. For description of special unit handling see Section 5. Other sources are

normally purchased power or interchange-in transactions.

Purchased energy or purchase will be used to denote a source from either of the transaction types. During the incremental allocation of energy to delivery transactions, the system configuration is made up of two types of purchases plus units. The purchase types are a) available for incremental allocation and b) not available for incremental allocation. All purchases can be available for incremental allocation of energy to a delivery transaction. Purchases are initially available by default and are subsequently made unavailable according to the following criteria: -

- i) For a single hour, a purchase will be made unavailable, if the entire energy purchased has been directly allocated to transmission delivery transactions.
- ii) A purchase will be unavailable for incremental allocation to a delivery transaction if the company from whom the purchase was made and the company to whom the energy delivery is made are the same.

If the delivery transaction is a member of a group the purchases will be available for the entire group, including the delivering company.

iii) A purchase will be made unavailable to a specific transaction or group if source allocation input specifically restricts this purchase from incremental allocations to any transaction in the group.

The purchase will be available for incremental allocation both preceding and following the transaction or group specified unless other criteria prevail.

### 3. Energy Allocation Processing

The term sources in this section refers to all sources of energy i.e. generating units and purchased energy. For any hour, the Reconstruction allocates energy from sources to delivery transaction(s). The allocation is performed in descending order of the sequence numbers assigned by SPPC to the transactions.

If the same sequence number is assigned to more than one delivery transaction, these transactions form a group.

A group is processed as if it were a single transaction. After the source allocation processing for the group is completed, the allocations are divided amongst members of the group in proportion to their delivery requirements.

Within any group/transaction processing, all direct allocations of energy as specified by SPPC are processed prior to incremental allocation of energy.

#### 3.1 Sequence Number assignment

Transaction sequence numbers are normally specified by SPPC and are entered into the MHO system by the system operators along with the system schedule data. The sequence numbers are retrieved from the MHO data sets by the ECR system.

The sequence numbers are used to determine the order by which transactions are to be incrementally processed. Transactions which are assigned the same sequence number for any hour are processed as a group for that hour. Transactions/ groups are incrementally processed in descending order of sequence number. The order in which transactions/ groups are processed is important because, as incremental allocation of sources for any hour proceeds, the marginal cost of energy allocated decreases. The decrease occurs because the slope of the heat rate curve decreases when moving down the curve from the high limit to the low limit.

The sequence number of a transaction/group, therefore, determines the cost of incrementally allocated energy for the transaction/group relative to any other transaction/group for the same hour.

The sequence numbers assigned to delivery transaction by SPPC normally indicate the relative order by which transactions would have been added to the AEP system internal load. Processing transactions and groups in descending order of sequence number, therefore, simulates the AEP system operation under various load conditions that could have occurred.

Sequence numbers for short lead-time transactions such as 'emergency' are normally higher than for those transactions with longer lead-time such as 'short-term'.

When a sequence number is not specified by SPPC it is determined by the ECR System. This situation will normally occur only if a transaction with direct allocation is not entered into the schedule for an hour (e.g., a specific request for spinning cost computation see Section 4.4).

A sequence number is assigned when needed according to the following logic in which the term spinning cost transaction is used to denote the transaction to which a sequence number is to be assigned.

- a) If, for the hour, there exist delivery transactions with other companies with the same transaction type and block number as the spinning cost transaction, the spinning cost sequence number is set so that the spinning cost will be incrementally processed immediately after processing the last of the matching transactions.

E.g., the spinning cost transaction is short term, block 2 and there exist 3 other delivery transactions A, B & C of short term, block 2 energy for the hour as follows: -