*** Draft ***
Concepts Paper on Economic Upgrades

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This paper proposes a region wide cost allocation with a postage stamp rate design for upgrades included in a balanced economic portfolio.

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Economic upgrades are described in Section III of this paper. Economic upgrades are those transmission upgrades and additions to the SPP Transmission System that have been shown to provide customers with potential savings that exceed the cost of the proposed transmission upgrade(s). An economic upgrade will reduce congestion on the SPP Transmission System and will therefore result in savings in Adjusted Production Costs. A portfolio of economic upgrades is a set of network upgrade groups that:

- Qualify for economic cost allocation; and
- Can be assumed to be implemented within a set time frame.

In order to qualify for economic cost allocation, the portfolio of economic upgrades must be approximately balanced. The requirements for a balanced economic portfolio are defined in Section V of this paper.

IC. Cost Allocation of Economic Upgrades

The proposed region wide cost allocation with a postage stamp rate design for economic upgrades is described in Section IV of this paper.

ID. Process of Balancing Benefits with Costs and Approving Economic Portfolios

In a balanced economic portfolio the benefits to each SPP zone must exceed the costs allocated to each SPP zone per the postage stamp rate design. Section IV describes the calculation of benefits and the benefit to cost ratio criterion. When a balanced economic portfolio cannot be achieved, Section V.B provides the ability to increase benefits to deficient zones through other means. Section V.C describes the process for approving the economic upgrades in a balanced economic portfolio to be included in the SPP Transmission Expansion Plan.

II. Introduction

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III. Economic Upgrades

IIIA. Description of Economic Upgrades

Economic upgrades are those transmission upgrades and additions to the SPP Transmission System that have been shown to provide customers with potential savings that exceed the cost of the proposed transmission upgrade(s). An economic upgrade will reduce congestion on the SPP Transmission System and will therefore result in savings in Adjusted Production Costs as described in Section IV.B.1.a.

An economic upgrade is not required to satisfy reliability criteria at the time the economic upgrade is expected to be completed. However, an economic upgrade may displace or defer the need for a reliability upgrade. Also, an economic upgrade is not required to accommodate either requests for transmission service or interconnection service pursuant to Attachments Z1 and V, respectively, of the SPP Tariff.

As part of the transmission planning process pursuant to Attachment O of the SPP Tariff, stakeholders, including regulatory authorities, may propose potential economic upgrades. Also, SPP staff may identify potential economic upgrades as a result of investigating Transmission Loading Relief (“TLR”) events and observing congestion on the SPP Transmission System. SPP performs a screening analysis of these potential economic upgrades in order:

- To establish a relative ranking of the potential economic upgrades based on the ratio of the estimated benefit to the estimated cost; and
- To aid in developing alternative portfolios of economic upgrades to achieve a general balance of benefits throughout the SPP Region.

The potential economic upgrades may be screened individually or in various combinations. As part of the transmission planning process, SPP solicits input from stakeholders and from the Regional State Committee on the metrics to be used to determine combinations of potential economic upgrades to be screened. In order to perform the screening analysis, for each potential economic upgrade or combinations of potential economic upgrades, SPP estimates the cost and the benefit due to the upgrade(s). The screening analysis provides a relative ranking of the potential economic upgrades. SPP considers the highest ranking potential economic upgrades in developing alternative portfolios of economic upgrades for more robust analysis as described in Section IV.B.

IIIB. Network Upgrade Groups that Qualify for Economic Cost Allocation

Network upgrade groups that qualify for economic cost allocation, as described in Section IV:

- Must be 345 kV and above ("EHV");
- May include lower voltage facilities needed to reliably integrate the EHV upgrade(s); however, the cost of the lower voltage facilities cannot exceed the cost of the EHV upgrade(s) included in the network upgrade group;
- Must meet the benefit to cost ratio requirements in Section IV.B; and
- Must be part of a balanced economic portfolio, as described in Section V.

Negative reliability impacts will be mitigated as part of the development of the network upgrade group and included as part of the network upgrade group. EHV to lower voltage transformers may not be included in network upgrade groups that qualify for economic cost allocation, except as provided in Section VI.B when a balanced economic portfolio cannot be achieved.

IIIC. Portfolio of Economic Upgrades

A portfolio of economic upgrades is a set of network upgrade groups that:

- Qualify for economic cost allocation; and
- Can be assumed to be implemented within a set time frame.

IV. Cost Allocation for Balanced Portfolio of Economic Upgrades

IVA. Postage Stamp Rate Design

Section IV.A describes the cost allocation, rate design and applicability of rates for an economic upgrade that is part of a balanced economic portfolio when the revenue requirement for such upgrade has been filed with and accepted by the Commission. For the purposes of determining the cost for the benefit to cost ratio, SPP will estimate the revenue requirement for each economic upgrade in the balanced economic portfolio.

1. Calculation of Revenue Requirements Using Fixed Charge Rate

For economic upgrades that are part of a balanced economic portfolio, SPP will calculate the revenue requirement for each economic upgrade in the portfolio using the applicable financial factors for each respective owner. The revenue requirement will include the costs necessary to support the economic upgrade, including operation and maintenance expenses, depreciation, property and payroll taxes, income taxes (if applicable) and return on investment. Annually, SPP will recompute the revenue requirement for each economic upgrade, to reflect changes in the costs to support the economic upgrade over time.

These costs for economic upgrades in a balanced economic portfolio will be allocated region-wide. In Attachment H to the SPP Tariff, these revenue requirements could be included in a manner similar to or with the Base Plan Region-wide Annual Transmission Revenue Requirement for the purposes of determining the charges to load within SPP as described in Section IV.A.2 and of determining the rate applicable to point-to-point transmission service.

2. Rate Application to Transmission Customers

The charges to support economic upgrades in a balanced economic portfolio will be assessed to:

- Network Customers taking Network Integration Transmission Service to serve their Network Load under the SPP Tariff;

- Transmission Owners providing transmission service to: (i) bundled retail load for which such Transmission Owners are not taking Network Integration Transmission Service or Firm Point-to-Point Transmission Service under the SPP Tariff; and (ii) load being served under Grandfathered Agreements for which such Transmission Owners are not taking Network Integration Transmission Service or Firm Point-to-Point Transmission Service under the SPP Tariff; and

- Transmission Customers taking Point-to-Point Transmission Service under the SPP Tariff.

These are the same customers, specified in Section 41 of the SPP Tariff, that are assessed the Base Plan Region-wide Charge.

IVB. Requirement for Benefit to Cost Ratio to Qualify for Cost Allocation

1. Calculation of Benefits

This section discusses a potential methodology to use to identify and measure the value of economic transmission upgrades proposed by SPP in the annual planning process.

Taken together, these types of benefits are often identified as “societal benefits”. The societal benefit is made up of a set of mutually agreed upon metrics that reflect the economic performance of various aspects of transmission investment. These metrics can then be combined via a mutually agreed formula. The final metric reflects the overall societal benefit of a project. These metrics can be calculated for transmission alternatives and compared to assist in final project selection.

a. Adjusted Production Costs: Application of Economic Model

To calculate the adjusted production cost metric, special software is used that estimates the unit commitment and economic dispatch of modeled generators within a context of a modeled transmission system and load delivery points. The commitment and dispatch of the generators is constrained by the software to ensure that no overloads will occur on any monitored transmission element (typically taken as the NERC book of flowgates, but can include additional potential future flowgates). This ability of these types of production cost programs to prevent the overload of transmission elements is commonly referred to as a "security constrained economic dispatch".[1]

Programs of this type are also able to emulate the forced outage of units. These programs can use Monte Carlo techniques to probabilistically force the outage of units for a time period of interest over many simulations. The average of these simulations is then calculated to create an estimate of the production costs to serve the load in the system studied.[2] The combination of randomly created forced outages along with the security constrained dispatch algorithm creates an effective simulation environment for capturing the economic benefits of various transmission investment alternatives.

The program outputs are related to the production costs of the units modeled in the simulation. These production costs are based upon the fuel used by each unit, variable O&M costs for each unit, fixed O&M costs for each unit, environmental costs for the unit. Furthermore, the adjusted production cost also takes into account the purchase/sales opportunities detected by the software between the various areas included in the model.

The adjusted production cost method proposed by SPP takes advantage of these outputs from the simulations to formulate an economic metric that has meaning for the customers served within the SPP footprint. The proposed metric is called the "adjusted production cost". Adjusted production cost would be calculated as follows:

Adj Prod Cost = Production Cost - Revenue from Sales + Cost of Purchases

where

Revenues from Sales = Net Export x Zonal $\text{LMP}_{\text{Gen Weighted}}$

and

Cost of Purchases = Net Import x Zonal $\text{LMP}_{\text{Load Weighted}}$

The adjusted production cost metric is especially useful for comparing transmission expansion alternatives. The adjusted production cost from one alternative can be compared to other alternatives to determine its relative economic performance. This metric can also be used directly in the calculation of present value and net revenue requirement for the purpose of regulatory justification.

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1 It is important to note that this security constrained dispatch feature is limited to thermal overloads only. This occurs since the program uses a DC load flow model to simulate the flows throughout the system. Therefore, the software is unable to dispatch generator to maintain voltage or prevent voltage collapse.

2 SPP is not currently using Monte Carlo for forced outages, but is using probabilistic techniques to simulation a single draw of outages.

b. Other Measurable Benefits

In addition to the adjusted production cost metric, there are other economic benefits to transmission investment that either are measurable now or could be with further development and refinement based upon SPP stakeholder input. Many of these items, perhaps all, could be measured using economic metrics for use in transmission project selection and regulatory justification. Additional benefits that can be readily measured using an economic metric include:

- Reduction in system losses;
- Differing environmental impacts; and
- Improvement to capacity margin and operating reserves requirements

Additional benefits that merit further consideration but which will require further development and refinement based upon stakeholder input include:

- Energy, capacity and ancillary service market facilitation;
- Increased competition in wholesale markets;
- Reliability enhancement, including storm hardening and black start capability; and
- Critical infrastructure and homeland security.

c. Quantifiable Benefit Metrics Using Currently Available Methods and Tools

1. Reduction in System Losses

   It is relatively easy to quantify the changes to system losses. There are two components, energy and capacity.

   The energy component of losses is a standard value provided by the simulation. It is a straightforward calculation to determine the change in losses among alternatives and the costs associated with such losses by multiplying the losses by the average marginal cost of energy supplied in the modeling output. The energy component is typically captured in adjusted production costs.

   The capacity component of losses can be determined either by looking at the peak hour loss reduction from the economic modeling runs or, alternatively, by comparing peak load AC powerflow simulations of the alternatives. The difference in losses on peak can be assigned a capacity value since a reduction of losses (or conversely an increase in losses) represents a reduction (increase) in the amount of capacity that must be purchases for the system under study. In this case, the stakeholders would have to assign a value for the capacity to be used in the analysis. Because the capacity impact occurs as marginal capacity, typically a rate applicable to peaking capacity is applied.

2. Differing Environmental Impacts

   It is also relatively easy to compute the economic value of differing environmental impacts from various transmission alternatives as these items, if modeled appropriately, are an output of the software. SO_2, NO_x, HG, Carbon and opacity are values that can be modeled for the fuel type used in the unit. To calculate, the stakeholders would need to reach agreement on the value per pound of each emission type.

The cost of emissions can be calculated for the base, system as is scenario. A transmission expansion alternative can allow more cost effective, lower emissions based power access to market. The emission cost reduction of this alternative can be calculated by taking the difference. This represents the environmental savings for the given transmission expansion alternative.

3. Improvement to Capacity Margin and Operating Reserves Requirements

   Planning reserve requirements have been set by the regions based upon a loss of (firm) load expectation ("LOLE") of 1 day for every 10 years. This approach uses expected values of incremental transfer capability on peak as part of the supply available to the system under study. Various transmission alternatives, especially large packages of projects such as the EHV projects, have an impact on these transfer capabilities. As a result, planning reserve requirements could be adjusted and, therefore, a capacity value of changes to planning reserve requirements can be calculated.

   Operating reserves are needed to regulate load changes and to support transmission contingencies without shedding firm load. Operating reserve requirements may also be adjusted to account for a more robust transmission grid and these benefits can be captured.

   To calculate these economic benefits, stakeholders would have to agree upon the methodology and the value of capacity to use in the calculation.

d. Potential Economic Benefit Metrics that Can be Developed Over Time

1. Energy, Capacity and Ancillary Service Market Facilitation

   Market structure matters in identifying the economic benefits related to the various markets impacts resulting from transmission investment. As price information becomes transparent, planners and interested stakeholders have access to information regarding the economic performance of the existing transmission system. This information can be used to glean insights into the value of transmission investment alternatives. For example, one method that is available for certain markets is to calibrate production cost simulations to emulate past market activity. Once calibrated, the simulation can be used to gain insights into proposed investment.

   Cost benefit calculations related to market facilitation (e.g., enhanced competition and increased liquidity), will likely need to wait until formal markets develop for energy, capacity, and ancillary services within the SPP footprint. Once a history develops for market based prices for a given product, then techniques can be created to estimate or bound market effects for economic benefit determination.

In the absence of formal markets, economic tools and competitive indices such as HHI[3] are well understood and can be calculated for given markets. However, indices such as HHI are designed to measure the level of monopolization of a market and, therefore, would be more appropriate for use as a supplemental metric for project selection.

2. Increased Competition in the Wholesale Markets

   Until SPP establishes a future market design and a cost history is developed, the adjusted production cost methodology will capture the underlying production cost savings due to reduction in congestion on the system resulting from the various transmission alternatives under consideration. Since rational market behavior would imply that suppliers would take full advantage of the supply and demand curve in constrained markets, the production cost savings should be an indicator of the minimum savings due congestion reduction.

   In Locational Marginal Pricing ("LMP") based markets, congestion can be readily measured by comparing LMP prices across nodes in the market and determining the value of increasing the capability of that interface. Security Constrained Production Cost programs can estimate these LMP differentials through the use of a shadow price calculation. As a result, impacts on congestion can be estimated. Stakeholder acceptance of this measure may require a history of market behavior to establish credibility.

   <u>Note Regarding Estimating Market Dynamics:</u>

   Even if LMP markets are not established, security constrained production cost programs can provide an estimate of LMP values by calculating the marginal price for energy at a given node in the system. These "shadow" prices can be used to identify pockets of congestion and help planners estimate future market behaviors.

3. Reliability Enhancement: Storm Hardening/Black Start Capability

   Storm hardening is a legitimate benefit of transmission investment. While various alternatives may satisfy planning criteria, the various alternatives will reinforce the grid in different ways. It is possible to use security constrained production cost programs and insurance valuation techniques to estimate the economic value of storm hardening for each alternative.

   To perform this work, stakeholders will need to agree on the list of key combinations of contingencies to use to represent the storm scenarios under study. In addition, probabilities should be assigned to each of these combinations for the final valuation to be

[3] HHI stands for Herfindahl-Hirschman Index. HHI is calculated by squaring the market concentration of each firm in a given market and summing these values. A market monopolized by one company would have an HHI of 10000.

determined. If pattern of certain outages has occurred in the past, perhaps due to hurricanes or tornados, those outage patterns may be used as the basis for the definition of the multiple contingencies.

Once these contingencies are identified, then SPP can use its security constrained production cost program to model these contingencies for each alternative and compare adjusted production costs during the storms and can also estimate and compare the unserved energy portion for each alternative for the given contingency sets. The probabilities can be applied to calculate a weighted cost for each transmission alternative.

4. Critical Infrastructure/Homeland Security

This item is also an indication of a reliability benefit, but can be calculated as an economic benefit. Generally, as transmission elements are added to a network, redundancy is added and the network becomes more robust. This has a direct relationship to the proposed CIP-002 standard in the use of contingency sets to identify critical infrastructure on the US electric system. Transmission alternatives may add different levels of "robustness" to the network with the varying level of ability to prevent the spread of events to a regional level. The more robust alternatives may be able to reduce or possibly eliminate the designation of critical infrastructure.

If combinations of contingencies are defined and used for the CIP-002 analysis, then these combinations can be modeled in the security constrained dispatch program similar to the method proposed for storm hardening. Costs and levels of un-served energy can be compared for the various alternatives.

<u>Note on Renewable Portfolio Standards ("RPS") Targets:</u>

Meeting RPS targets, if established by state or federal governments, should be included as part of the planning objectives of specific projects. Only transmission alternatives that satisfy these objectives should move forward for further evaluation. Therefore, a specific metric for inclusion in the societal benefit measure has not been proposed.

2. Benefits Calculated at Zonal Level

Adjusted production cost benefits are calculated on a zonal level within SPP for the purpose of comparing transmission expansion alternatives. This method does not calculate adjusted production cost benefits on a nodal basis. The method used is primarily a simplification technique used due to the fact that economic modeling programs do not keep track of which generators' outputs are changing due to internal changes and which generators' outputs are changing due to import/exports. Therefore determining the value of adjusted production costs on a zonal basis eliminates this problem.

In this calculation, all transactions are accounted for on the zonal level. Any change in purchases and sales between zones are priced according to the zonal LMP (generation weighted for sales and load weighted for purchases).

The zones used in this process that are internal to SPP are the zones specified in Attachment H of the SPP Tariff and listed Section IV.B.2.a. The zones used in this process that are external to SPP are the first tier zones listed Section IV.B.2.b. The option is available to increase or decrease the granularity of the internal and/or first tier zones.

a. List of Zones Included in the SPP Footprint

The following is a present list of zones in the SPP as specified in Attachment H of the SPP Tariff.

Zone 1: American Electric Power – West
American Electric Power (Public Service Company of Oklahoma, Southwestern Electric Power Company)
East Texas Electric Cooperative, Inc.
Tex-La Electric Cooperative of Texas, Inc.
Deep East Texas Electric Cooperative, Inc.
Zone 2: Reserved
Zone 3: City Utilities of Springfield, Missouri
Zone 4: Empire District Electric Company
Zone 5: Grand River Dam Authority
Zone 6: Kansas City Power & Light Company
Zone 7: Oklahoma Gas & Electric Company
Oklahoma Gas & Electric Company
Westar Energy, Inc. (Kansas Gas & Electric and Westar Energy)
Zone 8: Midwest Energy, Inc.
Zone 9: Aquila Networks-MPS/L&P
Aquila Networks-MPS
Aquila Networks-L&P
Zone 10: Southwestern Power Administration
Zone 11: Southwestern Public Service
Zone 12: Sunflower Electric Cooperative
Zone 13: Western Farmers Electric Cooperative
Zone 14: Westar Energy, Inc. (Kansas Gas & Electric and Westar Energy)
Zone 15: Aquila Networks-WPK

b. Description of First Tier Zones/Entities to Which SPP is Interconnected

The following is the present list of zones external, but directly interconnected to the SPP.

Zone 1: Nebraska Public Power District
Zone 2: Omaha Public Power District
Zone 3: Associated Electric Coop, Inc.
Zone 4: Entergy Corp. (Entergy Electric System)
Zone 5: Cleco Corporation
Zone 6: Lafayette Utilities System
Zone 7: Louisiana Energy & Power Authority
Zone 8: Ameren/MISO

c. Description of How Benefits Are Calculated at a Zonal Level

As described above, adjusted production cost savings are calculated on a zonal basis. To determine the zonal adjusted production cost benefit for each zone the following method is used:

Adj Prod Cost =
Production Cost - Revenue from Sales + Cost of Purchases

where

Revenue from Sales = Net Export x Zonal $\text{LMP}_{\text{Gen Weighted}}$

and

Cost of Purchases = Net Import x Zonal $\text{LMP}_{\text{Load Weighted}}$

This metric will determine the total adjusted production cost for each zone in a given area of interest. To determine the benefit derived from a transmission expansion project the metric must be calculated with and without the transmission expansion. The adjusted production cost of the scenario with the expansion is then subtracted from the scenario without. The resultant difference will be the adjusted production cost change.

3. Benefits Must Equal or Exceed Costs

SPP will calculate the costs and the benefits for each proposed portfolio of economic upgrades. SPP will calculate the annual benefits over a 10 year planning time frame by calculating the annual benefits for three specific years within the 10 year planning time frame (early year, intermediate year and late year) and estimating the annual benefits for the in between years. For example, SPP may calculate the annual benefits for years 1, 5 and 10 in the planning time frame and estimate the annual benefits for years 2, 3, 4, 6, 7, 8 and 9. SPP will estimate the revenue requirement for each proposed portfolio of economic upgrades over the same 10 year planning time frame.

In order for a portfolio of economic upgrades to qualify for economic cost allocation, the portfolio of economic upgrades must be a balanced economic portfolio, as described in Section V.A; and the benefits of the portfolio of economic upgrades must exceed the costs over the 10 year period analyzed.

The benefit to cost criterion is:

NPVB ≥ NPVC

Where:

NPVB = net present value of the benefits of the portfolio of economic upgrades over the 10 year period analyzed; and

NPVC = net present value of the revenue requirements for the portfolio of economic upgrades over the 10 year period analyzed.

A discount rate will need to be specified for use in the calculation of the net present value of benefits. For the screening analysis performed as part of the development of the 2007 SPP Transmission Expansion Plan, a discount rate of 8% per year was used to calculate the net present value of benefits over the 10 year period analyzed. Also, a sensitivity analysis to the discount rate could be performed as part of the process to develop alternative portfolios of economic upgrades.

The net present value of the benefits will be calculated only for SPP, unless a first tier entity as listed in Section IV.B.2.b agrees to participate in the allocation of costs pursuant to a seams agreement with such entity.

V. Process for Balancing Benefits with Costs and Approving Economic Portfolios

VA. Requirement for a Balanced Economic Portfolio

In order for a portfolio to qualify for economic cost allocation, the portfolio of economic upgrades must be a balanced economic portfolio. In a balanced economic portfolio, over the 10 year period analyzed, the benefits to each SPP zone must exceed the costs allocated to each SPP zone per the postage stamp rate design described in Section IV.A.

VB. Balanced Economic Portfolio Can Not be Achieved

SPP may not be able to achieve a balanced economic portfolio based on the description of network upgrade groups that qualify for economic cost allocation in Section III.B. In this case, in order to achieve a balanced economic portfolio, SPP may include lower voltage facilities that increase economic benefit to deficient zones. Such lower voltage facilities may include EHV to lower voltage transformers.

If a balanced economic portfolio still cannot be achieved, SPP may include existing zonal costs, or portion thereof, in the postage stamp rate to increase economic benefits to deficient zones. In this case, for the purposes of calculating the economic benefits, the existing zonal costs, or portion thereof, of transmission in service over the 10 year planning time frame will be included in the analysis. If a balanced economic portfolio is achieved by including the existing zonal costs, or portion thereof, in the 10 year analysis, then SPP will permanently move such existing zonal costs to the postage stamp rate. When?

VC. Process for Approval of an Economic Portfolio

As part of the transmission planning process pursuant to Attachment O of the SPP Tariff, SPP develops alternative economic portfolios; and performs an evaluation of costs, benefits and balance of each portfolio. In the winter of each year, SPP will make a recommendation of a balanced economic portfolio(s) to the Markets and Operations Policy Committee and Regional State Committee. Both the Markets and Operations Policy Committee and Regional State Committee will make recommendations to the SPP Board of Directors. The SPP Board of Directors will approve the economic upgrades included in the balanced economic portfolio as part of the SPP Transmission Expansion Plan.

VI. Balanced Economic Portfolio Flow Chart and Example

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