APPENDIX A
ALTERNATIVES EVALUATION STUDY

McClellanville Power Supply Alternatives Evaluation Study

Central Electric Power Cooperative, Inc.

September 2010

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1.0 Introduction

Central Electric Power Cooperative, Inc. (Central Electric) is proposing to construct a 115 kilovolt (kV) transmission line to Berkeley Electric Cooperative (Berkeley Electric)'s proposed McClellanville substation for the purpose of providing long-term reliable electric service to the McClellanville community and surrounding areas. This proposal would greatly reduce the number and length of extended outages in the area and the number of momentary interruptions (or blinks).

1.1 Description of Central Electric Power Cooperative

Central Electric is a wholesale power supplier owned by the twenty electric member distribution systems that it serves. Central Electric provides electricity to its member distribution systems in the state of South Carolina via a combination of the bulk electric system and its own transmission facilities. Central Electric owns approximately 668 miles of transmission lines.

Central Electric, founded in 1948 by its original member distribution systems, today serves more than 720,000 consumers in South Carolina. Central Electric's mission is to provide its member distribution systems a reliable and affordable supply of electricity while maintaining a sound financial position through effective use of human, capital, and physical resources in accordance with cooperative principles.

1.2 Purpose of the Alternative Evaluation Study

The U.S. Department of Agriculture's (USDA) Rural Utilities Service (RUS) provides capital loans and loan guarantees to electric cooperatives for the upgrade, expansion, maintenance, and replacement of the electric infrastructure in rural areas. Central Electric is pursuing financial support from the RUS for a new 115 kV transmission line to serve Berkeley Electric's proposed McClellanville substation. The transmission line would provide the power delivery infrastructure to increase the reliability and capacity of the existing electrical system serving the area.

RUS is required to evaluate potential environmental impacts of its federal actions in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's NEPA implementing regulations (40 Code of Federal Regulations [CFR] 1500–1508), and RUS's NEPA implementing regulations, Environmental Policies and Procedures (7 CFR 1794). RUS guidance regarding NEPA implementation for RUS actions requiring scoping (RUS Bulletin 1794A-603) requires that an Alternative Evaluation Study (AES) and a Macro Corridor Study (MCS) be prepared. RUS normally accepts these studies before starting the official NEPA process (i.e., issuing of a Notice of Intent [NOI] to prepare an Environmental Assessment or an Environmental Impact Statement). Central Electric has prepared this AES to evaluate electric system alternatives that best meet the purpose and need for the proposed project. Potential corridor alternatives are discussed in the associated MCS.

1.3 Purpose/Need for the Proposal

The purpose of the proposal is to provide long-term reliable electric service to the McClellanville community and surrounding areas by constructing a 115-kV transmission line to Berkeley Electric's proposed McClellanville substation. The McClellanville community is located in an area that currently has no existing transmission infrastructure. Transmission lines deliver power to the customer substations long distances away from generating plants at high voltages to ensure that power is transmitted much more efficiently with minimal power losses and voltage drops. These lines are also much more reliable than distribution lines because they: (1) have wider rights-of-way, (2) have more aggressive right-of-way clearing and tree trimming programs, (3) have wider spacing of wires (4) are constructed more solidly, and (5) are more solidly grounded.

1.3.1 Existing System vs. Proposed Project

A diagram, illustrating a complete power system, is included in this document as Figure 1. This diagram functionally represents what the electrical system would look like if the proposal were completed. A substation would be located in a load center (or an area where power is needed). A transmission line from the bulk electric system would then service or energize the load-serving substation. Distribution lines would then exit the substation and provide electric service to residents, commercial buildings, schools, farms, etc. This is a typical and universally desired method of providing electrical service to a substation because it results in a very reliable source for each of the distribution circuits leaving the substation.

Figure 2 is a map of the existing power system serving the McClellanville area. Berkeley Electric, a member Central Electric's system, serves the McClellanville area from a distribution system that is approximately forty (40) miles long from the nearest substation to the end of the distribution line. Geographically, this extends from the Mt. Pleasant area to the Santee River delta. The substation, identified as Hamlin, and approximately twenty-two (22) miles of distribution line, are owned and operated by South Carolina Electric & Gas Company (SCE&G). This SCE&G distribution line serves as the source to Berkeley Electric's McClellanville Metering Point, which serves the McClellanville community. Of all the delivery points provided to Berkeley Electric from Central Electric, this is the only one served by a long distribution line. Unlike transmission lines, the SCE&G distribution line serves other commercial and residential customers along the way and beyond Berkeley Electric's metering point. This 40-mile distribution line is difficult to maintain, creates voltage problems, and results in poor power quality/reliability to all the customers involved. Central Electric is Berkeley Electric's wholesale power provider and is therefore responsible for purchasing the power from SCE&G and reliably delivering it to Berkeley Electric to serve the McClellanville area.

1.3.2 Reliability and Its Measures

The reliability of the electric service provided to consumers is one of Berkeley's primary concerns. Likewise, one of Central's primary concerns is the reliability of electric service provided to Berkeley. Reliability to an electric utility is defined as an effort to keep the lights on as much as possible to as many customers as possible. Reliability of power systems is measured by industry standard indices that are calculated by the utility from actual data captured from electronic meters and/or controls.

Two of the most commonly used indices to measure system performance are the System Average Interruption Duration Index (SAIDI) and the System Average Interruption Frequency Index (SAIFI). SAIDI is the duration in minutes of interruption experienced by the average customer and is equal to the total customer interruption durations divided by the total customers served. . SAIFI is equal to the total number of customer interruptions divided by the total customers served. Please refer to Figure 3, titled SAIDI, 2004-2008 and Figure 4, titled SAIFI, 2004-2008. These charts show the SAIDI and SAIFI as calculated for the source for all of Berkeley's stations for the years 2004-2008. The reliability of the electric service being provided at the McClellanville Source is by far worse than any other station owned and operated by Berkeley, with the second being the Hamlin Metering Point that was replaced by a substation in 2008. As shown in Table 1 below, the SAIDI number for the McClellanville source is over 20 times greater than the typical source at Berkeley Electric. Replacing the McClellanville Metering Point with the McClellanville Substation and a transmission source would improve the reliability to customers in this area to a level equivalent to other customers on Berkeley Electric's system.

Table 1: Reliability Indices – McClellanville Source

Berkeley Electric Reliability Indices	McClellanville Source 2004-2008	Typical Berkeley Electric Source: 2004-2008[1]
SAIDI	623.24	29.95
SAIFI	4.21	0.34

[1] Average SAIDI and SAIFI source values from Berkeley Electric distribution system (as seen in Figures 3 & 4) with the McClellanville and Hamlin Metering Points excluded.

In addition to being measured at the source, reliability is also measured on the distribution system owned and operated by Berkeley Electric. The proposed McClellanville Substation, as shown on Figure 2 is located at a point that is central to the McClellanville area. This area is now being served from one circuit out of the McClellanville Metering Point, whereas the proposed McClellanville Substation would serve this same area with three circuits. The following Table 2 shows SAIDI and SAIFI calculations for the times that the circuit has gone out in addition to when the source was out:

Table 2: Reliability Indices – McClellanville Circuit

Berkeley Electric Reliability Indices	McClellanville Circuit 2004-2008	Typical Berkeley Electric Circuit: 2004-2008[1]
SAIDI	581.71	289.64
SAIFI	4.40	2.76

The SAIDI number is about twice as high as the typical circuit at Berkeley Electric. There are three ways to reduce this number: (1) reduce the duration of the outages, (2) reduce the number of outages that occur, or (3) reduce the number of customers affected. Since McClellanville is a remote area, it would be very difficult to decrease the duration as emergency response times would be above what is typical. However, serving the same area with three circuits versus one circuit would reduce the number of customers affected on many outages and bring the SAIDI more in line with other circuits on Berkeley Electric's system. The SAIFI number is also greater than the typical Berkley Electric circuit, and it is expected that this number would be reduced with the proposed project.

1.3.3 Voltage Levels

Berkeley Electric has a responsibility to provide voltage levels within industry standards to all of its customers. The most recent standard is the ANSI C84.1-2006 titled American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz). It is common for Berkeley Electric to use voltage regulators to help keep voltages within the specified ranges for all the customers served from a distribution line. A voltage regulator is an electrical device that automatically steps voltages up or down to maintain optimum voltage levels. Typically, Berkeley Electric has one set of voltage regulators installed on each circuit at its substations. In the case of the McClellanville Metering Point, two sets of voltage regulators are installed to boost voltages to acceptable levels. This is a "band-aid" solution that will become less effective with even the smallest amount of load growth in the area. Based on the loading on this equipment, another set of voltage regulators may be needed soon. In this case, growth on both Berkeley Electric's and SCE&G's distribution systems directly affects the voltage level delivered to Berkeley Electric's system.

1.3.4 Voltage Sags

Another concern related to voltages is voltage sags. These can occur when an object, such as a tree limb, makes contact with the distribution line. While every reasonable effort is made to keep distribution line rights-of-way as clear as possible, the number and magnitude of voltage sags are directly proportional to the length of the distribution line. This is due to the increased amount of exposure of the line to the environment and the technical characteristics of the wire (or conductor). When voltage sags occur: lights can either go dim or go out, motors can stall out or overheat, and computers can shut down or fail. As customers continue to add newer, more sensitive electrical and electronic equipment, this becomes a much greater concern.

2.0 Project Description

2.1 Proposed Action

The action being proposed by Central Electric is to build a single-circuit 115 kV transmission line from a Santee-Cooper Network transmission line to the proposed McClellanville substation to be constructed by Berkeley Electric. The transmission line macro-corridors from which a route would be selected range from 15 to 33 miles in length and vary in width from a few hundred feet to up a mile.

Current design features being proposed include: single pole structures with three phase conductors and a single 0.565 OPGW fiber optic overhead shield wire. The right-of-way would be cleared to 75 feet in width (37.5 feet on either side of the centerline) and would include the trimming or removal of danger trees (hazardous trees that could fall on the line) that may be outside of the right-of-way.

3.0 Alternative Evaluation

3.1 Alternatives Considered

In the sections below, the "no action" alternative, and other alternatives that address each aspect of the purpose and need for the proposal are discussed. As mentioned above, the most pressing need is to improve the reliability of the electrical service to the McClellanville community and surrounding area. However, each alternative that meets this purpose and need was also explored for its ability to support increased load or energy demand in the McClellanville area.

An economic power supply analysis of each source option was performed, at two different growth rates, by comparing the cost to upgrade the electrical system versus the preferred transmission alternative. Each alternative was evaluated over a 30-year timeframe. The *No Action Alternative* and the *Energy Efficiency/Conservation and Renewable Resources Alternative* are alternatives that require no changes to the existing distribution system, so there are no economic analysis comparisons for new construction.

3.1.1 No Action Alternative

Berkeley Electric has an assigned service territory that includes an area that is generally in the vicinity of the McClellanville community of Berkeley County, South Carolina. This is a unique coastal area that is effectively isolated by virtue of a number of natural boundaries, including the Atlantic Ocean to the east, the Santee River delta to the north and the Francis Marion National Forest to the west. As a result, electrification of the area meant providing service from the south. Long time environmental restrictions along with a relatively low population density in the area had created a situation where the existing power system either could not be expanded or it was not economically feasible.

Approximately twenty years ago, it became clear to the engineering and operations staff at Berkeley Electric that the existing facilities were not providing the community an acceptable level of service. The area is currently served by long distribution lines that extend over forty miles in length. These long lines pass through heavily wooded areas with relatively narrow right-of-way. These lines are difficult to maintain, create voltage problems, and thus result in poor power quality/reliability to all customers involved.

Electrical overload of the conductors causes the distribution lines to sag towards the ground and creates a public safety hazard. Also, the long distances that these circuits (or lines) have to reach presents a voltage problem where the existing equipment will not be capable of sustaining line voltages at acceptable levels, particularly at times when the usage in the area is at its maximum. This could cause appliances and motors to operate unacceptably or be damaged permanently.

While the system capacity and voltage levels are a concern for the near future, the area has already passed the point of unacceptable reliability with outages. Long distribution circuits (such as those that exist to serve the McClellanville area) are normally replaced with shorter circuits by locating a new substation as close to the load center as possible. A new substation requires a transmission line to serve it. Transmission lines are inherently more reliable than distribution lines due to their physical isolation from nearby vegetation and electrical isolation from consumers (i.e., the only loads are other substations).

Over the years, the population of the McClellanville area has minimally grown, resulting in a slightly increased electrical load. While the present system is still able to accommodate the existing load, even a very small growth rate (lower than what has been seen in recent years) would result in a situation where the existing power lines would not have the capacity to serve those growing loads, particularly at those times such as hot summer days or cold winter days when consumers are attempting to cool or heat their homes.

By failing to provide a more reliable source of power to the McClellanville community than presently exists, the community would continue to experience reliability issues. These issues will become even further aggravated by load growth (which would affect voltage and outage concerns). Berkeley Electric can continue to use a "Band-Aid" approach as long as it is necessary to attempt to maintain as high a level of service reliability as possible with the existing distribution lines. However, continuing to use such an approach would not solve the long-term reliability issues that are present in this area.

3.1.2 Energy Efficiency/Conservation and Renewable Resources

Central Electric is working with Berkeley Electric and its other member distribution systems in South Carolina to promote and improve energy efficiency and conservation. Central Electric has in place statewide load control, used at peak load times, and is developing renewable resources. On the energy efficiency side, Central Electric and its member distribution systems will have distributed over 1.9 million compact fluorescent light bulbs (CFLs) by the end of 2010 and has in place a pilot weatherization program for residential consumers. Central Electric and its member distribution systems are also working with the South Carolina Energy Office to provide grants to improve over

1,200 homes with various energy efficiency measures and determine which ones are the most effective. The member distribution systems plan to weatherize 20-30% of residential homes over the next 10 years. This is a huge effort that will reduce annual energy consumption by 180 to 270 million kilowatt-hours (kWh). Central Electric's renewable energy program includes the purchase of qualified green energy through our net metering program. Net metering allows the customer to put additional power generated from solar panels, windmills, or other distributive generation equipment back onto the distribution power lines. Central Electric pays the customer for this localized distributed generation of power.

Central Electric and Berkeley Electric will continue to pursue and promote efficiency improvements, increased conservation, and utilization of renewable resources with vigor, and these efforts should help reduce the load growth that is straining the existing system to some extent. However, these efforts do not provide relief to one of the main factors supporting construction of the transmission line, which is the poor electrical reliability experienced by the cooperative members in the McClellanville area compared to the members on the rest of Berkeley Electric's system.

3.1.3 Rebuild Existing Distribution System

This alternative evaluates rebuilding the existing distribution system to serve the McClellanville area. It requires an upgrade on the SCE&G system, including a new distribution substation at SeeWee, and a new 20 mile 795 SAC feeder from See-Wee to McClellanville. This alternative also requires a new 21 mile double-circuit 477 ACSR line from Jamestown.

With an aggressive growth rate of 4.88%, a capital cost of $6,900,000 would be invested in building an upgraded distribution system from the new SCE&G Seewee substation with the new double circuit distribution circuit from Jamestown for loads over 10 megawatts (MW). The system would be operated over 30 years and the cost of the system losses would be calculated and brought back to a value today of $80,051,850. The total system cost over the lifetime would be $86,951,850. The total system cost is the capital cost plus the value today of system loss cost.

For a more conservative 2.5% growth rate, a capital cost of $6,900,000 would be invested in building an upgraded distribution circuit from a new SCE&G Seewee delivery point with a second distribution circuit from Jamestown for loads over 10 MW. The system would be operated over 30 years and the cost of the system losses would be calculated and brought back to a value today of $62,004,970. The total system cost over the lifetime is $68,904,970.

3.1.4 On–Site Generation

This alternative evaluates the construction of the McClellanville substation with on-site generation initially capable of serving up to 6 MW. Banks of 2-MW diesel generator units were evaluated as an on-site generation alternative. Multiple generator units could be added as needed to serve the community where individual units could be temporarily taken down for repair. The initial capital cost of this project is $12,100,000. In the 4.88% growth case, the fourth generator would be added during the first year of operation due to the projected increase in load. The system is operated over 30 years and the cost of the system losses would be calculated and brought back to a value today of $89,842,364 for a 4.88% growth rate and $52,906,588 for a 2.5% growth rate. The total system cost over the lifetime is $101,942,374 and $65,006,588 respectively.

The analysis concluded that the on-site generation capacity for the McClellanville community is not an economical remedy to the reliability issues. The largest expense to on-site generation is the cost of fuel, which is not only expensive but as a commodity, has a large fluctuation in price.

3.1.5 Preferred Alternative: New Transmission System

The transmission line alternative was considered as the preferred alternative to provide reliable electric service to the McClellanville community. All of the transmission alternatives evaluated in the MCS would provide an alternative source of power into the McClellanville service area. They are evaluated using the same growth rates as the rebuilding existing distribution and on–site generation cases. In each of the cases the system is operated over 30 years and the cost of the system losses is calculated and brought back to today's equivalent value.

There are five basic transmission alternatives that have been considered. Each one of these provides transmission service from a bulk transmission source. The cost of constructing transmission to serve a growth rate of 4.88% in the McClellanville community produces a range from $63,632,903 to $72,329,266. The cost of constructing transmission to serve a growth rate of 2.5% in the McClellanville community produces a range from $48,299,553 to $57,127,599.

The first alternative is installing a switch in the Belle Isle area and constructing approximately 14-17 miles of 115 kV transmission line to the proposed McClellanville substation. The Santee Delta is included within the macro-corridor of this transmission line alternative.

The second transmission alternative is constructing a 230/115 kV switching station/substation in the Britton Neck area (Britton Neck 1 & 2) and constructing approximately 14-15 miles of transmission line to the proposed McClellanville substation.

The third transmission alternative is constructing a 230/115 kV switching station/substation near an existing 230 kV transmission line in the Honey Hill area (Honey Hill) and constructing approximately 10 miles of transmission line to the proposed McClellanville substation. The Frances Marion National Forest is included within the macro-corridor of this transmission line alternative.

The fourth alternative is tapping the existing Jamestown substation and constructing approximately 21 miles of 115 kV transmission line to the proposed McClellanville substation. The Frances Marion National Forest is included within the macro-corridor of this transmission line alternative.

The fifth alternative is tapping near the existing Charity Generation plant's substation at 115 kV and constructing approximately 28-33 miles of 115 kV transmission line to the proposed McClellanville substation. The Frances Marion National Forest is included within the macro-corridor of this transmission line alternative.

Table 3 presents an executive summary analysis of all possible future service alternatives to the McClellanville area. The capital cost of the installed facilities and the present value of the system loss cost were combined in the project total cost. Both a 2.5% load growth and a 4.88% load growth were assumed over the 30 year period. Load refers to the amount of power being used by all of the customers. The 4.88% load growth was forecasted in the area before the economic recession. A 2.5% load growth was used to evaluate the effects caused by the economic recession. Both growth rates band or bracket the 3.5 % growth rate used in the 2005 analysis.

Table 3: McClellanville Future Service Options Executive Summary

Macro Corridor Routes	Load	Transmission Capital Cost	Distribution and Substation Costs	Total Lifetime Cost
Rebuilding existing distribution to serve the McClellanville area	4.88% 2.50%	$0 $0	$6,900,000 $6,900,000	$86,951,850 $68,904,970
Building transmission from a new source to provide service to the McClellanville area	4.88% 2.50%	$10,229,722 to $16,843,447 $10,229,722 to $16,843,447	$2,156,900 $2,156,900	$73,862,510 to $85,276,185 $58,529,160 to $69,942,835
On-site generation	4.88% 2.50%	$12,000,000 $12,000,000	$100,000 $100,000	$101,942,374 $65,006,588

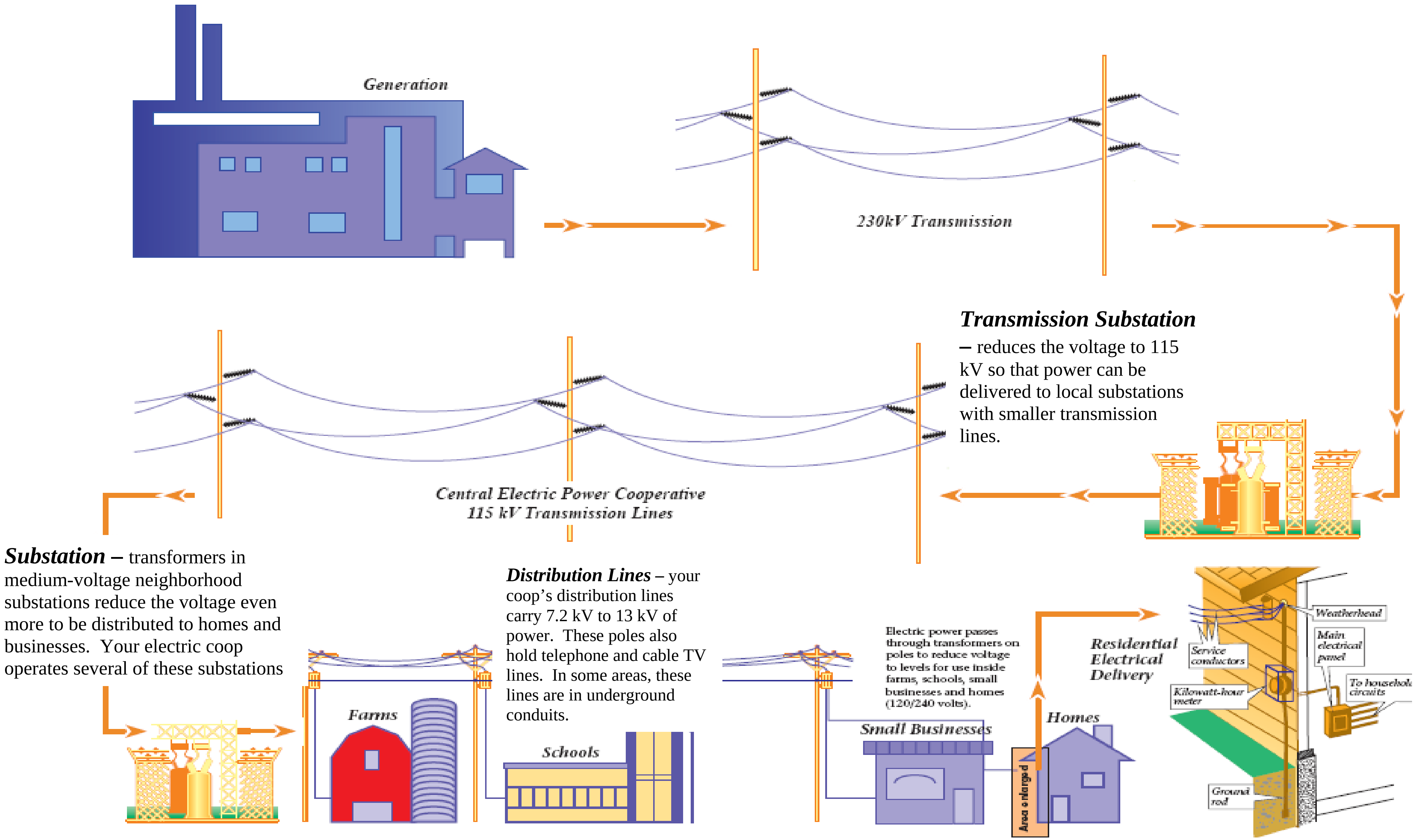

Figure 1: Diagram of a Complete Power System

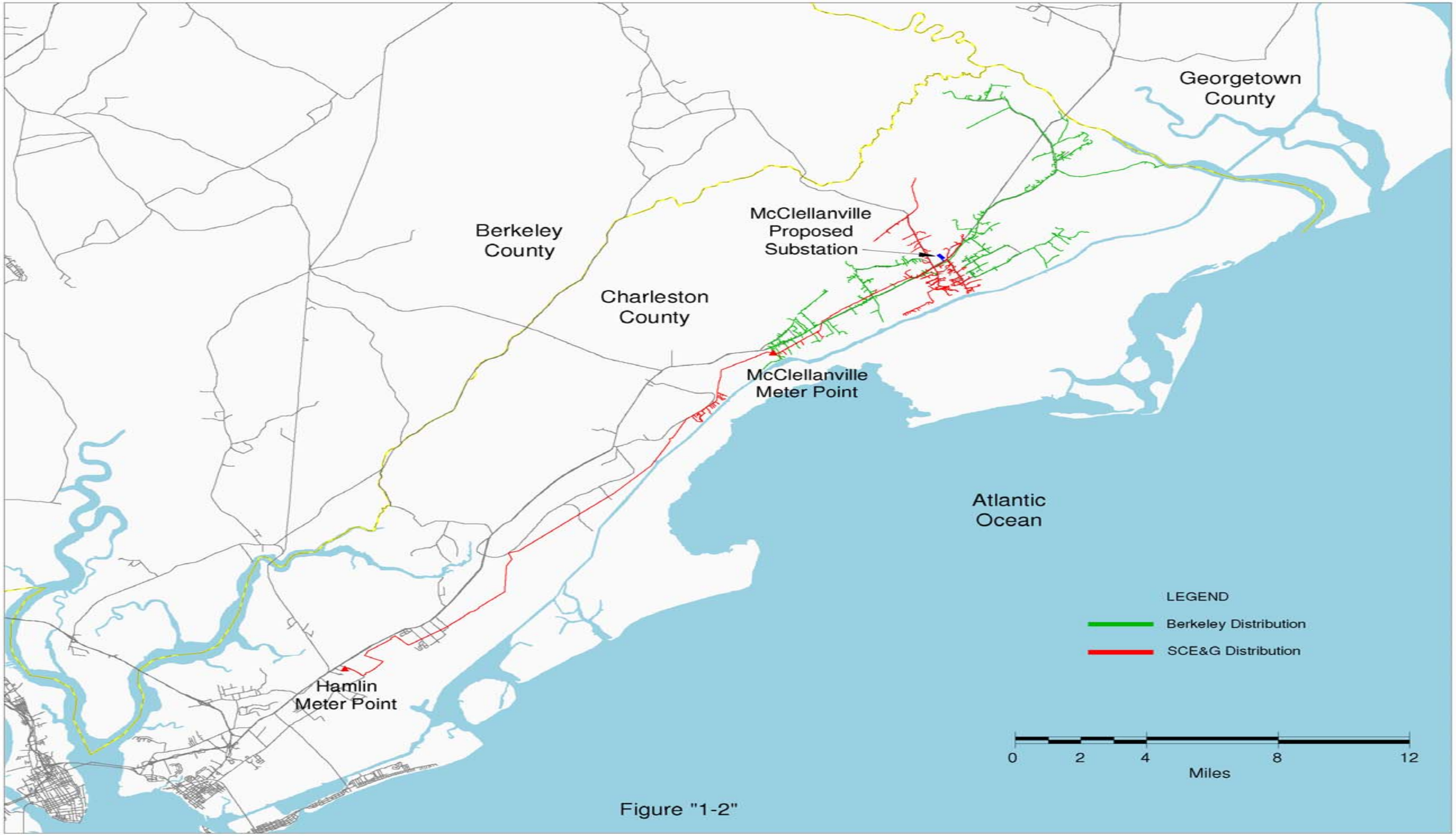

Figure 2: Map of the Power System Serving McClellanville

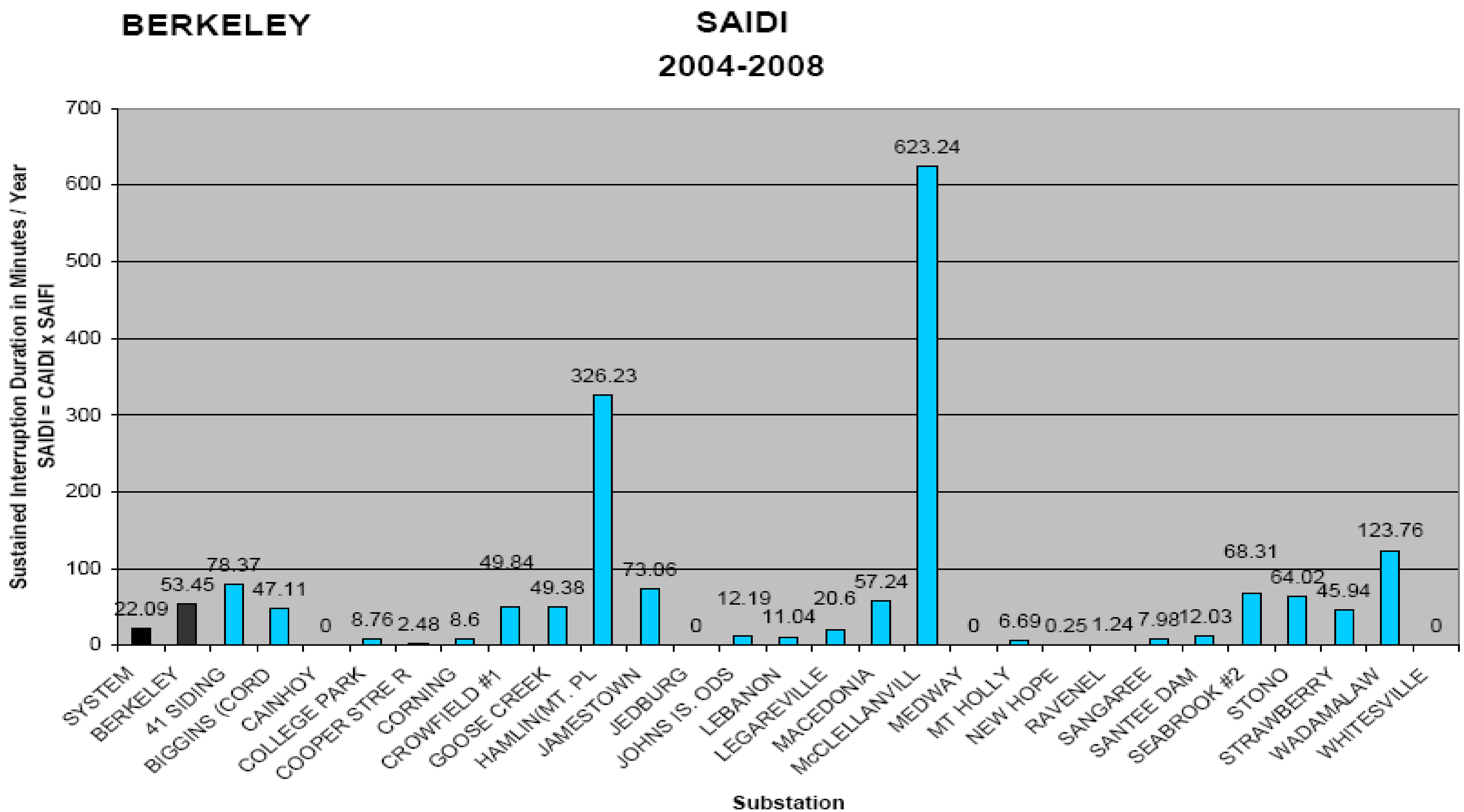

Figure 3: Source SAIDI Index for Berkeley Electric Cooperative from 2004-2008

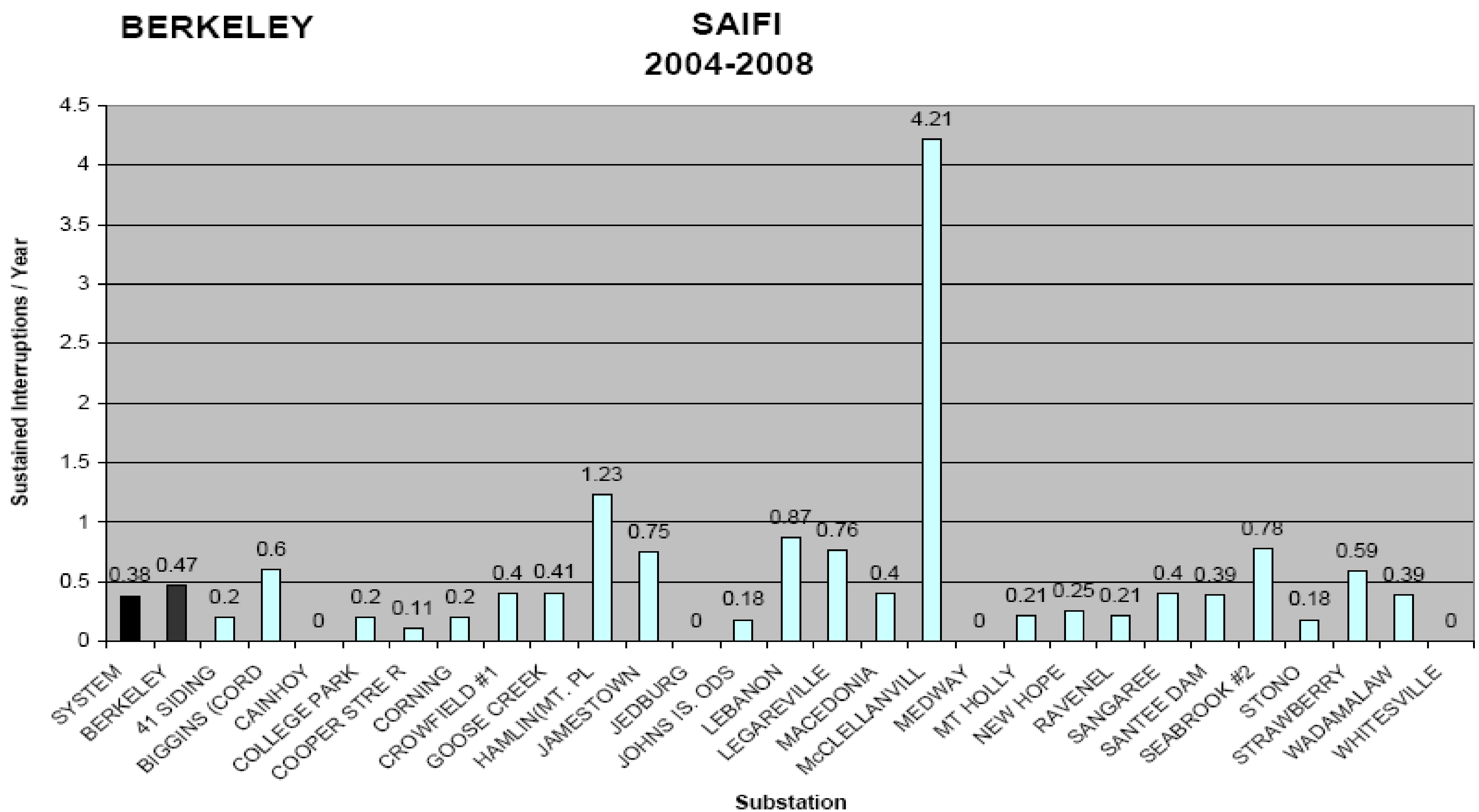

Figure 4: Source SAIFI Index for Berkeley Electric Cooperative from 2004-2008