



WDAT 1363

WDAT

System Impact Study

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**SOUTHERN CALIFORNIA
EDISON**

An EDISON INTERNATIONAL™ Company

Prepared by:

Alejandro Parra

Distribution Engineer

Approved by:

Patrick McConahay

Distribution Engineering Supervisor Desert Region

Roger Salas, P.E.

Principal Advisor, Electric System Planning

SOUTHERN CALIFORNIA EDISON COMPANY

Executive Summary

[REDACTED] applied to Southern California Edison (SCE) for interconnection and distribution service for its proposed [REDACTED] [REDACTED] pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT"). SCE performed a System Impact Study as requested by [REDACTED] for a 33 kV interconnection from the existing Palmview 33 kV distribution circuit. The interconnection is an applicant owned 33 kV Switchgear, which will be located approximately 2.37 circuit miles from [REDACTED] [REDACTED]. The request is for a WDAT Solar PV generation facility with a total capacity of [REDACTED] MW. The initial request is for service to commence by December 12, 2016.¹

The new generation, consisting of photovoltaic panels, [REDACTED] [REDACTED] will receive interconnection service from SCE's existing Palmview 33 kV distribution circuit out of Garnet 115-33 kV Substation via an overhead line extension to the applicant owned 33 kV group-operated switch and 33 kV Main Breaker, where their protective device(s) will be installed. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's Devers Substation.

The purpose of the System Impact Study is to determine the effect(s) of the proposed generating facility on the SCE distribution system and to identify the Interconnection Facilities, Distribution Upgrades, additions or modifications, and/or other facilities required to provide the requested service.

The study showed that the [REDACTED]

- Did not result in a violation of SCE's thermal loading criteria under both base case and N-1 conditions for the SCE distribution system for peak load and light load conditions.
- Did not result in a voltage rise exceeding Rule 2 requirements.
- Did not result in additional SCE protection requirements
- Neither the three phase and/or single line to ground short circuit fault currents increased beyond the 0.1 kA threshold. Therefore no substation circuit breakers will need to be replaced.

¹ Date as requested in the application. Actual operating date depends on design and construction requirements.

Non-Binding Order of Magnitude Cost Estimate²³

Non-binding order of magnitude cost estimates for the required interconnection facilities and system upgrades are as follows:

Case A: The facilities that are triggered by the addition of the [REDACTED] and are required exclusively by the Project for interconnection and distribution service.

Case B⁴: The facilities that are triggered by projects queued ahead of the [REDACTED] but may be required by the [REDACTED] as a result of a change in the interconnection queue, or may need to be advanced by the Project based on results of operating studies.

Cost Estimate

Case A

<u>Distribution Upgrades</u>	\$0 k
<u>Interconnection Facilities</u>	
Electrical Equipment	\$189.8 k
• Two (2) new poles	
• One (1) 33 kV overhead remote automatic recloser (RAR)	
• Approximately 400 feet of 336 ACSR overhead cable	
• 33 kV primary metering and associated wiring	
Corporate Environmental Services	\$33.3 k
• CEH&S to support Interconnection Facilities	
Real Properties	\$8.4 k
• Real Properties to support Interconnection Facilities	
Telemetry	\$6.1 k
ITCC (22%)	\$50.9 k
Total non-binding order of magnitude cost estimate	\$288.5 k

² The Cost Estimate does not include the cost required for civil work completed by the customer

³ The Cost Estimates are in 2016 constant dollars

⁴ The Case B cost estimate only includes upgrades on the SCE distribution system triggered by higher queued projects.

Case B

Distribution Upgrades

\$84.7 k

- New Bi-Directional Transducer at Garnet 115-33 kV Substation
- RTU Point Addition

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Introduction to Part A

[REDACTED] applied to Southern California Edison (SCE) for interconnection and distribution service for its proposed [REDACTED] [REDACTED] pursuant to SCE's Wholesale Distribution Access Tariff ("WDAT"). SCE performed a System Impact Study as requested by [REDACTED] for a 33 kV interconnection from the existing Palmview 33 kV distribution circuit. The interconnection is an applicant owned 33 kV Switchgear, which will be located approximately 2.37 circuit miles from [REDACTED] [REDACTED]. The request is for a WDAT Solar PV generation facility with a total capacity of [REDACTED] [REDACTED]. The initial request is for service to commence by December 12, 2016.⁵

The new generation, consisting of photovoltaic panels, [REDACTED] [REDACTED] will receive interconnection service from SCE's existing Palmview 33 kV distribution circuit out of Garnet 115-33 kV Substation via an overhead line extension to the applicant owned 33 kV group-operated switch and 33 kV Main Breaker, where their protective device(s) will be installed. The generated power would be delivered to the California Independent System Operator ("CAISO") grid at the 220 kV bus of SCE's Devers Substation.

The purpose of this study is to determine the impact of the proposed generating facility on the SCE distribution system and to identify the Interconnection Facilities, Distribution Upgrades, additions or modifications, or other facilities required to provide the requested service. This study was performed for the expected year 2015 through 2024 peak load conditions as well as low demand conditions.

The study was performed in two parts: Part A, performed by SCE's Distribution Engineering department, examines the impacts related to the SCE distribution system. Part B, performed by SCE's Transmission & Interconnection Planning department, examines the impacts and facilities related to the bulk power system. This is the Part A study report. More information related to Part B is included in Attachment B.

⁵ Date as requested in the application. Actual operating date depends on design and construction requirements.

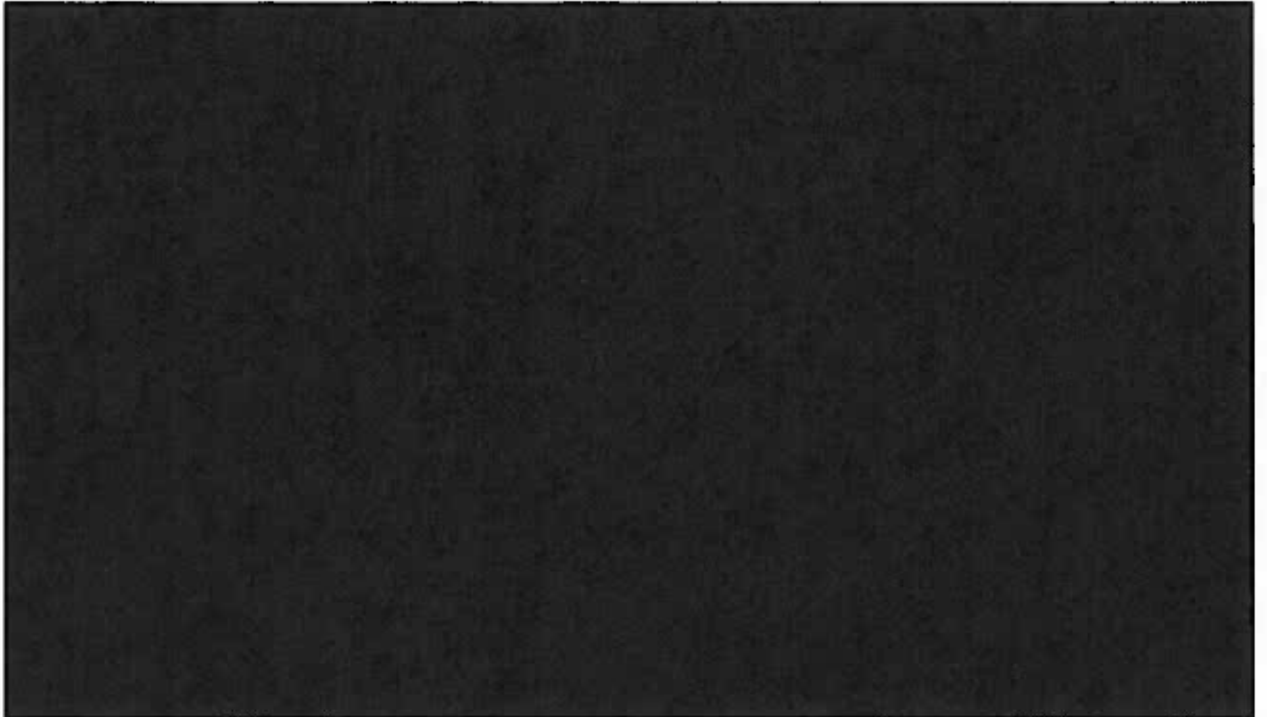


Figure 1 – Proposed method of service

Part A: System Impact Study Conditions & Methodology

Planning Criteria

The thermal rating of any conductor, connector, or apparatus shall not exceed 100% of its normal rated capacity with all facilities in service.

The thermal rating of any conductor, connector, or apparatus shall not exceed 100% of its emergency rating under N-1 conditions.

Operational flexibility and reliability of the distribution system shall be maintained at all times.

Circuit voltage profiles should be maintained to comply within CPUC's Rule 2 requirements.

System Conditions

The new generating facility must maintain the power factor at unity at rated output unless otherwise specified by SCE.

The new generating facility must be designed to be able to operate within a power factor range from [REDACTED] per WDAT requirements.

The generation system must be designed to accommodate a VAR schedule that will be provided by SCE. SCE will determine if the VAR schedule is necessary based on future re-arrangements of SCE's distribution system.

Expected loading on the distribution system as projected by the SCE 2015-2024 plan was used.

Distributed Generation Resources connected to the distribution system are analyzed offline and online during peak load and minimum load conditions during the day as to determine worst case scenario.

The short circuit contribution from the inverter systems was determined using customer provided inverter manufacturer datasheets.

This study does not include analysis that considers power output rate of change which may occur due to the following or other unspecified conditions:

1. Generator "morning start up" for solar systems. This may occur each morning the generating facility commences to generate and export electrical energy to the distribution system.
2. Cloud Cover. Solar generating facilities may have significant generation output variation (***Variability***) which can have an impact on grid distribution system voltage profiles.

The customer's generating facility will have equipment, software, and the appropriate controls in place to be able to control the generation output rates of change, as specified by SCE, in order to maintain appropriate voltage levels under all conditions including, but not limited to, the conditions identified above. Upon execution of the appropriate Interconnection Agreement, SCE will provide the Interconnection Customer the required ramp rate control parameters. The ramp rate controls will be a function of the generation penetration on the distribution system as well as SCE's distribution system configuration but other parameters may be considered. Therefore, changes to the ramp rate control scheme may be required from time to time as required by increased in generation, changes in the distribution system topology, or other changes in the distribution system.

Part A: System Impact Study Results

Short Circuit Analysis

Using the short circuit models from the inverter systems being utilized for this solar generation project it was calculated that the addition of the [REDACTED] did not result in the increase of three phase and/or single line to ground short circuit duties of 0.1 kA.

System Protection Considerations

With this proposed method of service, changes to the protection system of the SCE electrical system are not required.

Thermal Loading

The line section between the customer's facility and the 33 kV Point of interconnection is expected to experience a reverse power flow of approximately [REDACTED] during minimum loading conditions. In aggregate with other generation projects [REDACTED] will flow back on the [REDACTED] during minimum loading.

No thermal overloads were triggered by the [REDACTED]

Under emergency (N-1) conditions (loss of circuit), SCE may deem it necessary to isolate this project during emergency conditions until the distribution system returns to normal conditions.

Under emergency (N-1) conditions (loss of substation transformation), SCE may deem it necessary to isolate this project during emergency conditions until the distribution system returns to normal conditions.

Under other emergency or other abnormal circuit conditions, including localized equipment failures and area outs, SCE may deem it necessary to isolate this project until the distribution system returns to normal conditions.

Distribution Voltage Control

The Palmview 33 kV circuit is not expected to experience a voltage rise exceeding allowable Rule 2 requirements due to the addition of the [REDACTED]

The [REDACTED] must be able to operate at a power factor range of [REDACTED] [REDACTED] at the point of interconnection as required by the WDAT tariff. Additionally, the generation system must be designed to accommodate a VAR schedule provided by SCE if SCE deems it necessary, now or in the future.

Harmonic Impact

The harmonic impact of the subject inverter based generation was not part of this System Impact Study. Despite the relatively low THD (<3%) of the equipment, impacts on voltage distortion levels may be significant due to the penetration level of the generation facility with respect to the local distribution grid strength. As with all equipment connected to the SCE distribution system, the generation project will be subject to the provisions of CPUC Rule 2.E, allowing SCE to require customer mitigation of interference with SCE service, including harmonic impacts, if harmonic interference is caused by the customer. Given the amount of generation and the strength of the distribution system, SCE will not require a harmonic study but encourages that the applicant completes a harmonic study during the Facility Study Phase to insure that the generation facility complies with the harmonic studies outlined in CPUC Rule

2.E. If the applicant chooses to complete a harmonic study, SCE will then provide the required SCE distribution system data that are to be used as part of the harmonic study.

Part A: General Description of Identified Upgrades

Distribution Upgrades

Distribution Upgrades will not be required to interconnect the system unless Case B, as stated above, is used.

Interconnection Facilities

Interconnection facilities will be required to interconnect the system. Interconnection facilities include the installation of a two (2) new poles, One (1) new 33 kV remote automatic recloser (RAR), approximately 400 feet of 336 ACSR overhead cable, and 33 kV metering and associated wiring.

Telemetry requirements

Real-time telemetry will be required. In order to meet the telemetry requirements SCE is planning to utilize a new method telemetry which utilizes a centralized RTU concept. The cost estimate to comply with the telemetry requirements using the new method is \$6.1 k⁶

Customer Equipment

The interface protection will be provided by the applicant and will include a group-operated switch and a 33 kV Circuit Breaker. The applicant's protection must be coordinated with SCE's Protective device(s) to provide adequate protection for SCE's distribution system. The relay settings are subject to SCE approval prior to setting and certified timed trip testing report results using primary injection will need to be provided to SCE to verify relay and circuit breaker performance prior to energizing the service.

The [REDACTED] must meet SCE's published Electrical Service Requirements ("ESR") to the extent applicable. Drawings required by the ESR shall be submitted, reviewed, and approved by SCE.

Applicant generation interconnection equipment must comply with SCE's Interconnection Handbook in regards to generation protection and lockable, visible open disconnecting means at the point of interconnection. Additionally, the applicant will be responsible for the installation and costs of certain underground facilities (i.e. ducts, structures, etc.) to the extent required by the final design. The construction of the underground facilities will be as per SCE's project drawings.

System Study

⁶ Cost estimate does not include 22% ITCC.

A Facilities Study may be performed to conclusively determine the detailed scope and cost of facilities required to interconnect the project.

Part A: Non-Binding Order of Magnitude Cost Estimate

Cost Estimate⁷⁸:

Case A

<u>Distribution Upgrades</u>	\$0 k
<u>Interconnection Facilities</u>	
Electrical Equipment	\$189.8 k
<ul style="list-style-type: none"> • Two (2) new poles • One (1) 33 kV overhead remote automatic recloser (RAR) • Approximately 400 feet of 336 ACSR overhead cable • 33 kV primary metering and associated wiring 	
Corporate Environmental Services	\$33.3 k
<ul style="list-style-type: none"> • CEH&S to support Interconnection Facilities 	
Real Properties	\$8.4 k
<ul style="list-style-type: none"> • Real Properties to support Interconnection Facilities 	
Telemetry	\$6.1 k
ITCC (22%)	\$50.9 k
<hr/>	
Total non-binding order of magnitude cost estimate	\$288.5 k

Case B

<u>Distribution Upgrades</u>	\$84.7 k
<ul style="list-style-type: none"> • New Bi-Directional Transducer at Garnet 115-33 kV Substation • RTU Point Addition 	

⁷ The Cost Estimate does not include the cost required for civil work completed by the customer

⁸ The Cost Estimates are in 2016 constant dollars

Part A: Summary

The Part A System Impact Study showed:

1. Distribution upgrades will not be required to interconnect the system unless Case B, as stated above, is used.
2. Interconnection facilities will be required to interconnect the system. Interconnection facilities include the installation of a two (2) new poles, approximately 400 feet of 336 ACSR overhead cable, one (1) new 33 kV remote automatic recloser, 33 kV metering and associated wiring.
3. Real time telemetry will be required for this project to provide directional Watts and VARs magnitude from the generating facility to the SCE distribution system.
4. Interconnection service pursuant to the WDAT would be expected to commence approximately 9 months from the execution of a Generator Interconnection Agreement (GIA). However, schedules and duration may change due to the number of projects approved and release dates. Stacked projects may impact resources, system outage availability, and environmental windows of construction.
5. Upgrades identified are general and preliminary descriptions only. The costs indicated are non-binding order of magnitude only. The schedule is projected and preliminary.
6. Applicant is responsible for the installation of Underground Structures and conduits needed for the interconnection in accordance with SCE design.
7. A Facilities Study detailing required scope and cost of the identified upgrades may be completed prior to proceeding with the project.
8. This System Impact is based on various technical data previously provided by the applicant. If any of that information changes significantly, as determined by SCE, the results of this study may no longer be appropriate and may necessitate a new study.
9. Current distribution standards are being updated to address generation interconnection systems. The proposed method of service on this report may change according on final design to comply with the latest distribution design standards.
10. This report does not include all Real Properties evaluations and cost estimates. Where formal rights of way, easements, land leases, or permits are required by SCE for

installation of facilities, on or over Applicant's property, or the property of others, the Applicant shall grant SCE the rights of way and easements for the electrical facilities.

11. For SCE facilities and scope of work not subject to CPUC's GO 131-D, SCE will follow the requirements of all applicable environmental laws and regulations and issue an in-house Environmental Clearance before commencement of construction activities. The cost estimates provided assume that SCE will provide oversight on facilities and scope of work on the customer's property and/or SCE will perform all required environmental activities for SCE facilities and scope of work, located outside of the customer's property, from the siting through the post-construction phases. However, it is recommended for SCE facilities and scope of work to be included in the Generator's Environmental Licensing and Permitting documents to streamline the environmental process and avoid unnecessary delays in construction. The responsibilities for performing certain environmental activities may be negotiated during or after the Interconnection Agreement process.
12. This report does not consider potential milestone setbacks that could result from the local jurisdiction requiring underground construction of distribution facilities. SCE encourages the Interconnection Customer to consult with the local jurisdiction to identify existing underground ordinance to reduce the risk of complication associated with said ordinance.
13. This study does not include analysis related to the following system variability conditions:
 - a. Generator ramp rate: Solar photovoltaic generator's increasing output profile during sunrise, i.e. system start-up
 - b. Generator output variability: Solar photovoltaic generator's output variation correlated with weather conditions, i.e. cloud cover

This study assumes that the Interconnection Customer's generating facility will include all equipment, software, and appropriate controls necessary to maintain the generator output profile per SCE requirements. The Interconnection Customer will be responsible for maintaining designated voltage levels under all conditions, including but not limited to the conditions identified above. Upon execution of the GIA, SCE will provide the Interconnection Customer with the required ramp rate control parameters. The ramp rate controls will be a function of the generation penetration on the distribution system, as well as SCE's distribution system configuration (additional parameters maybe considered, as need). Changes to the ramp rate control scheme may be required as determined by increased generation, changes in the distribution system topology, or other changes in the distribution system.

14. Applicable to projects requesting primary service: This study does not include analysis related to coordination of system protection equipment. A coordination study may be required during final engineering. The coordination study may identify additional interconnection requirements such as installing new protection equipment, reprogramming and/or relocating existing protection equipment. The additional scope of work may have an effect on the Interconnection Customer's requested in-service date.

15. In order to supply and maintain proper voltages for SCE's customers as required by the CPUC, SCE's primary distribution voltage may fluctuate by as much as $\pm 5\%$ from the nominal values. SCE uses various voltage regulation techniques to raise or lower primary distribution voltages in order to maintain the customer's service voltage at the desired level. Producers interconnected at primary distribution voltage levels must be able to withstand such voltage changes. The step-up transformer ratio must be chosen such that the Producer can meet its voltage regulation obligations over the expected SCE system voltages. In the event, the customer is changing, replacing, or purchasing new equipment the customer shall acquire equipment to properly function with SCE's voltage regulation techniques.

Attachment A: Part A - System Diagrams

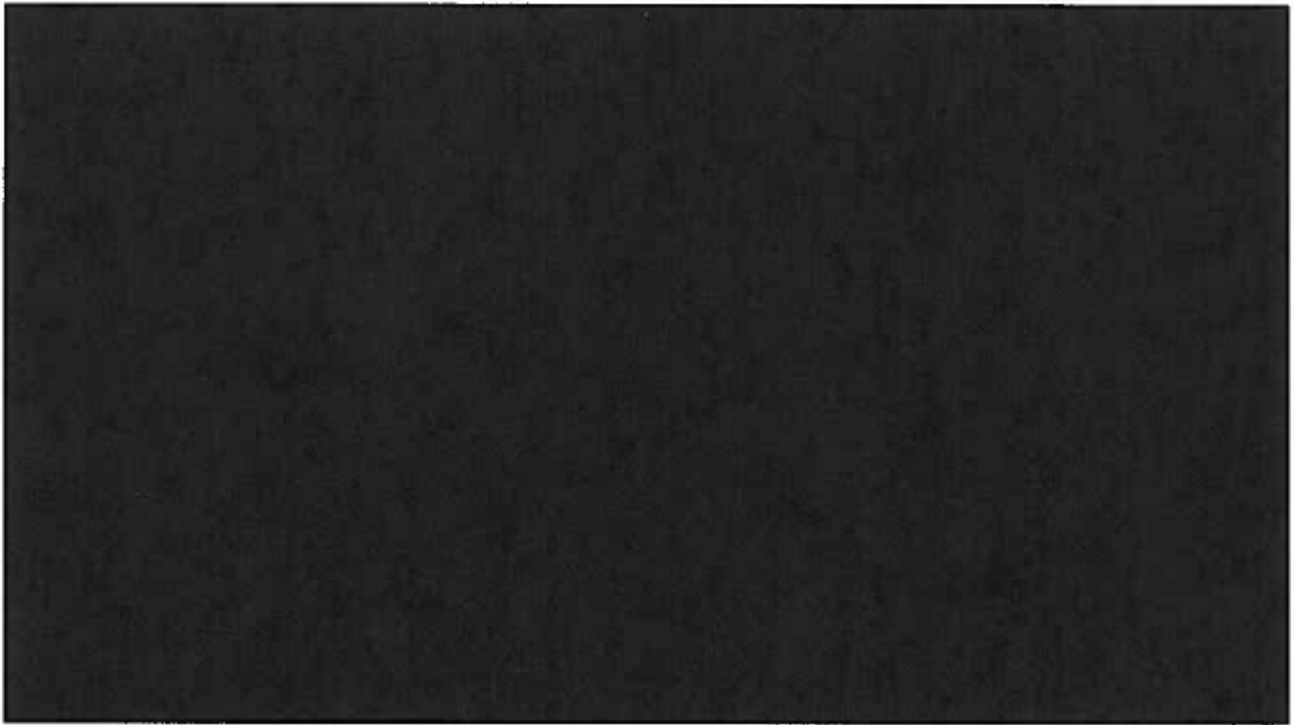


Figure 1 – System without proposed project

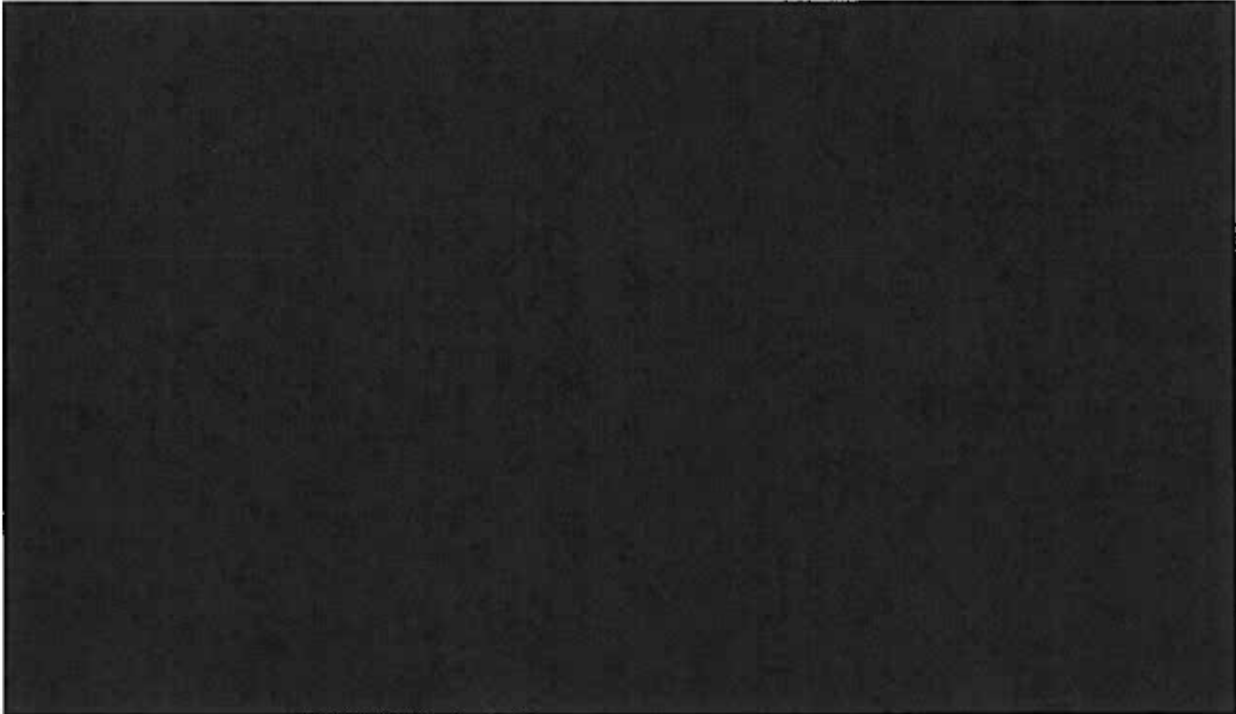


Figure 2 – System with proposed method of service

Attachment B: Transmission Assessment