Technical Report
LAX Master Plan EIS/EIR

3c. People Mover Technical Report

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Los Angeles World Airports
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Prepared by:

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LAX MASTER PLAN

AUTOMATED PEOPLE MOVER CONCEPTS APPENDIX

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1.0 Purpose and Goals of the Automated People Mover

1.1 Introduction

A primary component of the on-airport ground access plan for LAX is an Automated People Mover(s) (APM). This section describes the APM alternatives that correspond to the airport alternatives, the goals of the APM planning, the methodology used to analyze the alternatives, and the comparative assessment of the APM alternatives. In addition, this section provides a discussion of the qualitative evaluation of APM alternatives including the relative environmental benefits/mitigation offered by each APM alternative.

The goal of the planning process is to develop an integrated airport master plan that can accommodate the projected growth in airport operations, balance the needs of the airport users with the operational requirements of the airport, minimize the negative impacts of airport growth to the surrounding community, integrate the APM(s) with the existing and planned future airport facilities and roadways, and through phased implementation, permit the continued operation of the airport during construction.

1.2 Automated People Movers

APMs provide efficient, reliable, convenient, and frequent service thereby enhancing passenger service. APMs provide environmental benefits over conventional bus alternatives because the electrically-powered vehicles do not produce exhaust emissions and are quieter. These systems offer more convenient and predictable service because they operate on a dedicated guideway and are not affected by, and do not contribute to, roadway traffic and congestion. The APM contributes to the LAX environmental mitigation program by reducing the potential growth in the number of vehicle miles traveled as well as reducing roadway-based congestion and emissions, all of which offers air quality benefits over conventional bus alternatives. The APM system is expected to assist in the attainment of many regional transportation goals including those of L.A. County Congestion Management Plan and the regional Air Quality Management Plan.

1.3 On Airport Circulation Goals

A primary transportation goal of the LAX Master Planning effort is to provide convenient and efficient ground access. The APM is planned to be an integral part of an intermodal transportation system that will make circulation around, and access to and from the airport faster, more reliable, and more convenient.

The Automated People Mover system will support the transportation goals of the LAX Master Plan to mitigate local ground transportation impacts and improve local circulation (on-airport and immediately adjacent).

Use of APMs as a means of on-airport circulation is being proposed to provide improved service and convenience for airport passengers, employees, and visitors circulating between the terminals, long-term parking, and the rental car facilities. The development of the APM alternatives responds to the on-airport circulation needs of each of the airport alternatives by maximizing APM ridership potential and providing alternatives that serve rider groups efficiently.

2.0 Analytical Procedures and Assumptions

The methodology used in the development of the APM alternatives is as follows:

1. Develop alternative schematic alignments for each of the airport alternatives. Coordinate the APM alignment layouts with the development and phasing of new on-airport terminal and ground transportation facilities that best serve the function required, maximize potential ridership, and minimize the impacts to the existing airport facilities.

2. Review ridership forecasts developed by others and estimate the peaking factors within the design hour to develop system capacity design requirements.

3. Using Lea+Elliott's proprietary computer model LEGENDS©, analyze the system

performance of the APM for the alternatives and develop estimates of system capacity provided, fleet requirements, and passenger level of service provided. Level of service criteria includes passenger trip times between stations and passenger wait times. Compare alternative train operational scenarios to determine the best balance of meeting passenger level of service and train performance requirements and goals. Modify the alignments based on the results of the operational analysis.

4. Estimate the system capital cost for each of the APM alternatives.

5. Estimate the power consumption for each of the APM alternatives in terms of annual usage and peak demand.

6. Evaluate the alternatives based on level of service provided, number and types of riders served, and potential environmental mitigation offered.

The analysis of alternatives and the assumptions used in the analysis are summarized in the following attachments.

Attachment A-	APM Ridership Analysis
Attachment B-	Train Performance Modeling
Attachment C-	Passenger Trip Times
Attachment D-	System Capital Cost Estimate
Attachment E-	Energy Consumption Analysis

3.0 Characteristics of Airport Alternatives

3.1 APM Planning Assumptions

The basic planning assumptions used in the development of the APM alignments and routes are to:

1) integrate the APM with the existing and planned facilities, to minimize constructibility impacts and cost (CTA Terminal facilities will be retained, therefore impacts to the facilities in this area will be minimized);

2) minimize the walking distances to/from the APM stations;

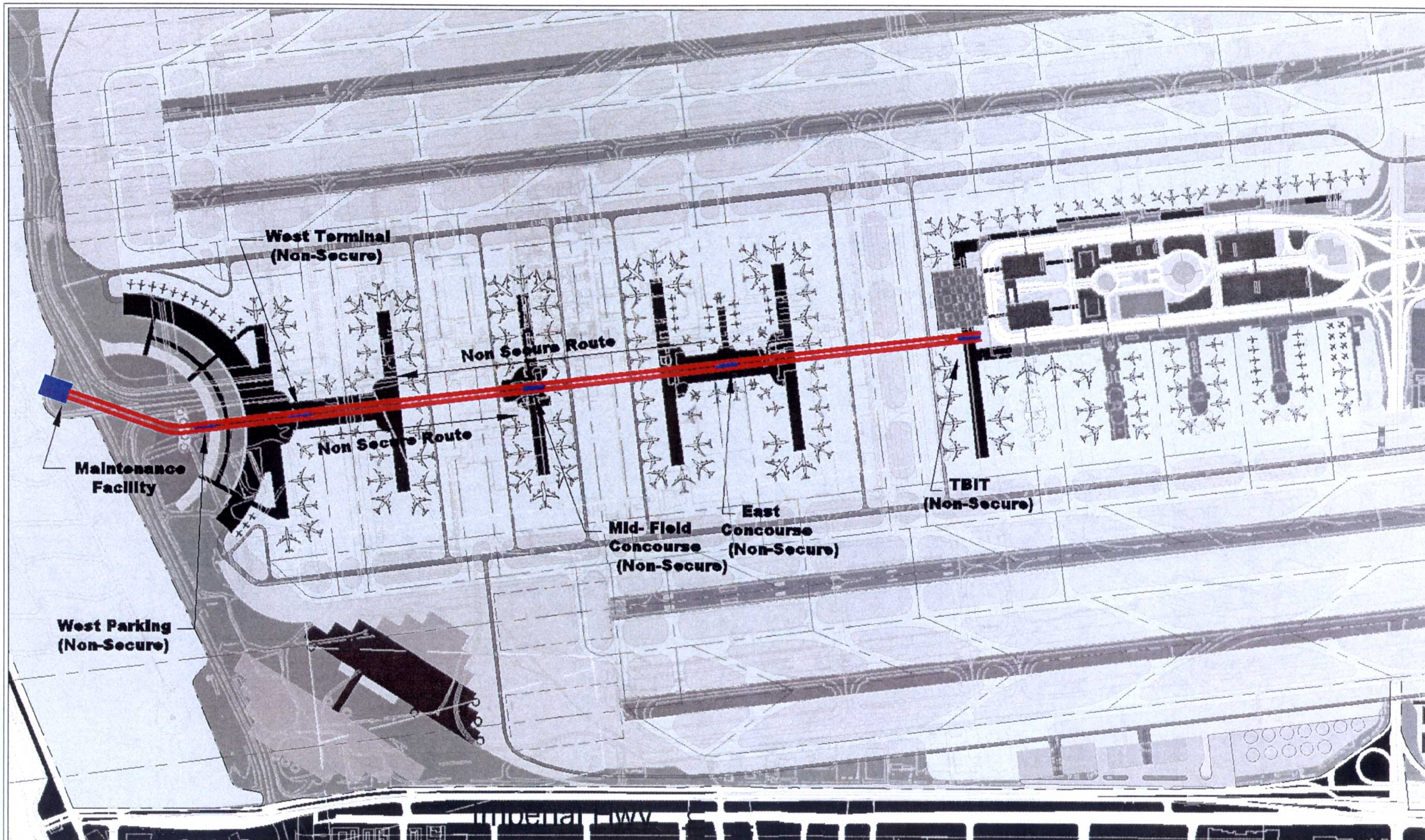
3) and place the stations based on the location of the activity centers.

The APM technologies under consideration for this project are conventional large scale APMs; based on the length of the alignment options, alignment configurations, operating speeds required, and carrying capacities required (cars are 35-55 feet long, 8-10 feet wide, carry 50-100 passengers per car, travel at least 30 mph, and have either rubber tires or steel wheels on steel rails).

3.2 Description of APM Alternatives

3.2.1 Alternative A

The Alternative A APM system serves passengers, employees and visitors on a single non-secure alignment. Figure 1 depicts the APM guideway alignment with the Alternative A Airport Plan. The Alternative A APM serves the West Parking garage, the West Terminal, the Midfield Concourse, the East Concourse, and the TBIT. The trains will operate in a pinched-loop configuration: traveling in one direction on one guideway to an end station then switching over onto a parallel guideway and traveling back in the opposite direction. The alignment is planned to be underground in a tunnel. There will be an APM maintenance facility west of the West Parking Garage.



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LAX Master Plan/ EIR/ EIS

Alternative A APM Alignment
Figure 1

Alternative A APM Alignment

Figure 1

APM System Description

Underground System
Dual-lane Guideway
Pinched-Loop Operation
Non-Secure Passenger Service
Center Platforms

Passenger Service Characteristics

Remote Check-in at WP Station
Frequent Service
Requires Other Means of Circulation in CTA

The ridership demand estimates that were used as a basis for the train performance analysis for the Alternative A APM are included in Attachment A. The Train performance analysis and assumptions that were used in the analysis are shown in Attachment B. In this alternative, all passengers, employees, and visitors are combined on a single non-secure route. No separate service is provided for International Arrivals Passengers or Domestic Transferring Passengers. International Arrivals Passengers must clear customs before accessing the stations in the non-secure area. Similarly, Domestic Arrivals Passengers that are transferring to another flight in another concourse must leave the secure area and access the non-secure station to connect to another concourse. The combination of passenger types results in very high peak hour passenger demand. The heavy passenger demand forecast for this alternative was so high that it was not possible to achieve the passenger capacity by headway reduction alone. It was necessary to modify the maximum train length goal for four-car trains. This goal was set for two reasons (1) to minimize the station platform length and (2) so as to not preclude any of the large (self-propelled) APM technologies from competing (as some are currently limited to a maximum of a four-car train length). The maximum train length goal of four-car trains was increased to seven-car trains to accommodate the passenger demand without having two separate systems at substantial infrastructure cost. In this Alternative, all of the trains stop at each of the stations. Each of the stations has a center platform. Because every train must stop at each of the stations, the passenger level of service provided to Domestic Transferring Passengers is slightly worse in this alternative. However, since Alternative A is intended to be a low cost alternative, the passenger service criteria were relaxed to reduce the guideway infrastructure costs. Reference Attachment B for a more detailed discussion of the operational parameters of each Alternative.

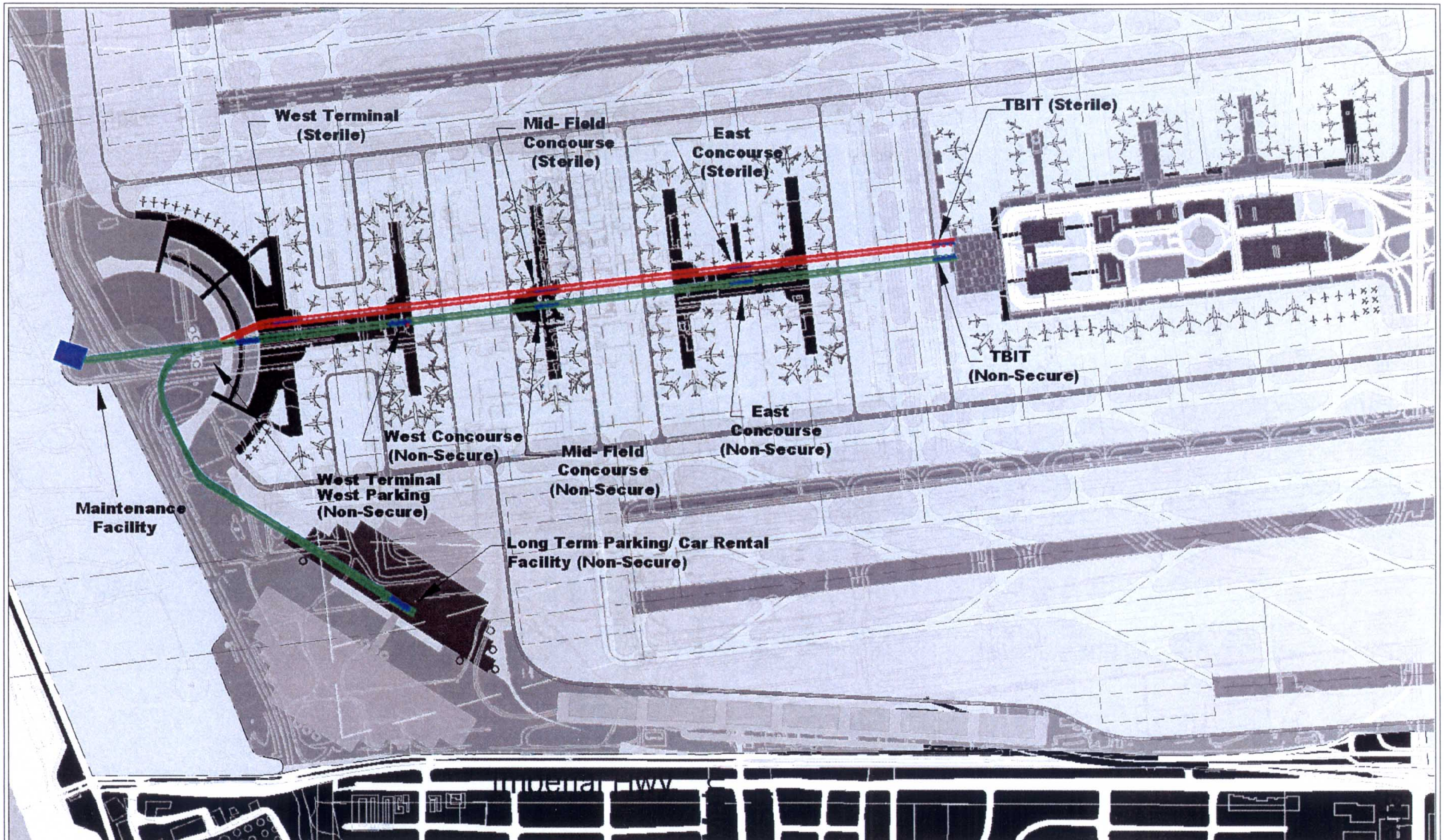
Passenger level of service information for this alternative is summarized in Attachment C. An APM system-only capital cost summary for all alternatives is provided in Attachment D. A power demand and consumption analysis is provided in Attachment E.

3.2.2 Alternative B

The Alternative B APM system serves passengers (both sterile and non-secure), employees, and visitors. Figure 2 depicts the APM guideway alignment with the Alternative B Airport Plan. The Alternative B APM serves the Long-Term Parking/Car Rental facility, the West Parking Garage, the West Terminal, the West Concourse, the Mid-field Concourse, the East Concourse, and the TBIT. Two separate guideway alignments are provided, one dedicated to sterile route passengers, and the other dedicated to non-secure route passengers. The trains on both routes will operate in a pinched-loop configuration: traveling in one direction on one guideway to an end station then switching over onto a parallel guideway and traveling back in the opposite direction. Both guideway alignments are planned to be underground. There will be an APM maintenance facility accessible to vehicles from both routes west of the West Parking Garage.

The two routes are parallel, except that the non-secure route extends to the Long-Term Parking/Car Rental facility, and the secure route does not. Both routes will operate in the same direction.

The ridership demand estimates that were used as a basis for the train performance analysis for the Alternative B APMs are included in Attachment A. The train performance analysis and assumptions that were used in the analysis are shown in Attachment B. In this alternative, all Domestic Transferring passengers, employees, and visitors are combined on a single non-secure route. International Arrivals Passengers are separated onto the sterile route. Domestic Arrivals Passengers must leave the secure area and access the non-secure station to connect to other areas of the airport. The combination of Domestic Arrivals Passengers, visitors, and employees sharing the same route results in very high peak hour passenger demand. The heavy passenger demand forecast for this alternative was so high that it was not possible to achieve the passenger capacity by headway reduction alone. It was necessary to modify the maximum train length goal for four-car trains. This goal was set for two reasons (1) to minimize the station platform length and (2) so as to not preclude any of the large (self-propelled) APM technologies from competing (as some are currently limited to a maximum of a four-car train length). The maximum train length goal of four-car trains was increased to six-car trains to accommodate the passenger demand without having two separate systems at substantial infrastructure cost. Reference Attachment B for a more detailed discussion of the operational parameters of each Alternative.



Lea+Elliott | 0 400' 800' 1600' | LAX Master Plan/ EIR/ EIS | Alternative B APM Alignment Figure 2

Alternative B APM Alignment

Figure 2

<u>APM System Description</u>

Two Underground APM Systems
- Dual-lane, Pinched Loop for International Arrivals Passengers (sterile)
  - Center Platform Stations
  - Connects Midfield Concourses to FIS Facilities
- Dual-Lane, Pinched Loop for non-secure Passengers
  - Center Platforms
  - Connects TBIT, Midfield Concourses, West Concourse, West Terminal/ West Parking, and Long Term Parking/RAC

<u>Passenger Service Characteristics</u>

Non-secure Trains Stop at Mid-Field Concourses
Passenger Circulation in CTA must be provide by other means
Provides Connection between TBIT and WT Development/RAC Frequent/Direct Service

All of the stations on the two routes have center platforms accessible to trains traveling in either direction.

Passenger level of service information for this alternative is summarized in Attachment C. An APM system-only capital cost summary for all alternatives is provided in Attachment D. A power demand and consumption analysis is provided in Attachment E.

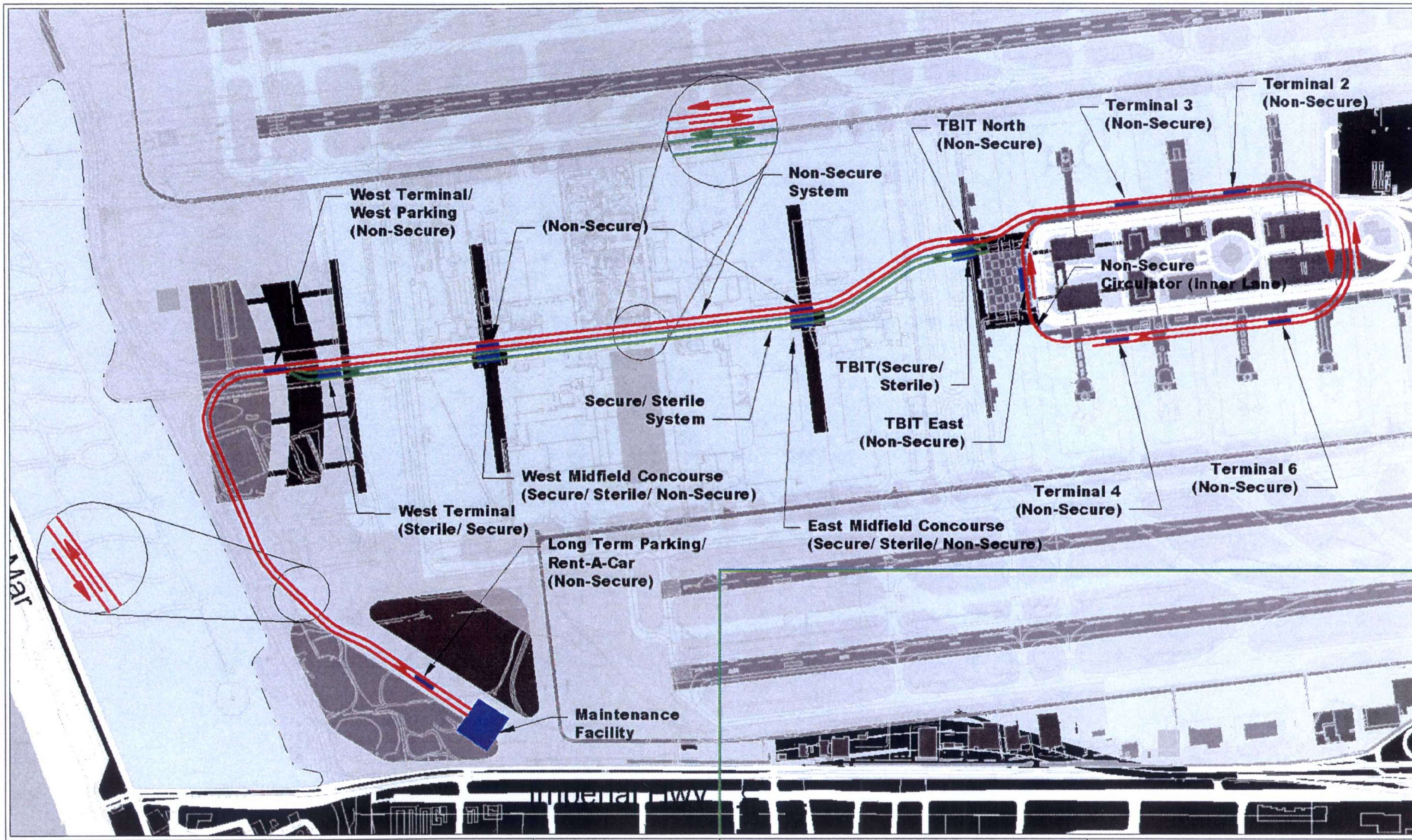
3.2.3 Alternative C

The Alternative C APM system serves passengers (secure, non-secure and sterile), employees, and visitors. Figure 3 depicts the APM guideway alignments with the Alternative C Airport Plan. In this alternative, there are two APM system alignments serving four routes. One alignment serves the International Arrivals Passengers (sterile) and the Domestic Transferring Passengers (secure). The trains on this alignment operate in a pinched-loop configuration between the West Terminal, the West Mid-field Concourse, the East Mid-field Concourse, and the TBIT. Trains and platforms are separated to prevent mixing of secure and sterile passengers. The other APM alignment carries non-secure passengers on two routes. One route on the non-secure alignment operates as a pinched loop connecting the Long-Term Parking/Car Rental facility, West Terminal/West Parking, the West Mid-field Concourse, the East Mid-Field Concourse, the TBIT, Terminal 3, Terminal 2, Terminal 6 and Terminal 4. The other route on the non-secure alignment operates as a loop within the CTA. This route acts a circulator within the CTA and connects the TBIT, Terminal 3, Terminal 2, Terminal 6 and Terminal 4. This route shares the inner lane of the non-secure pinched-loop route, but rather than turning back at the Terminal 4 station, cars on this route continue on to the TBIT station. The alignment is planned to be underground in the area of the airport west of the TBIT, but as the guideway enters the CTA it emerges and becomes elevated. There will be an APM maintenance facility to the southeast of the Long-Term Parking/Car Rental station.

The ridership passenger demand estimates that were used as a basis for the train performance analysis for the Alternative C APMs are included in Attachment A. The train performance analysis and assumptions that were used in the analysis are shown in Attachment B. This option allows the passenger demand requirements to be met with trains that are a maximum of four cars long. It should be noted, however, that the headway on the secure/sterile route had to be reduced below the minimum headway goal of 120 seconds to meet the passenger demand on that alignment. It should also be noted that on the non-secure alignment, since there are two separate routes operating, and that they are sharing a portion of the guideway, space has been made between every fourth two-car train for a single-car train on the circulator. Therefore, the headway between five successive trains on the pinched-loop non-secure route is 120 seconds between the first and second train, 120 seconds between the second and third train, 120 seconds between the third and fourth and 240 seconds between the fourth and fifth. This results in an average system headway of 150 seconds. When this train routing schedule is synchronized with the Circulator route, the headway on the circulator is 600 seconds or 10 minutes.

Lea+Elliott investigated other system operations that would also satisfy passenger demand. One other solution was generated where one fewer two-car train would operate on the non-secure pinched-loop route. This solution would decrease the headway on the Circulator route, but the average headway on the non-secure pinched-loop route would increase. Since the non-secure pinched-loop route carries significantly more passengers, this method of operation was not selected. It should also be noted, however, that the power analysis was performed using the most conservative assumption for each non-secure route. This has been done for two reasons: first, since the minimum headway between trains is 120 seconds, the power distribution substations must be sized to consider the minimum headway for proper operation, and second, using the minimum train separation yields a conservative estimate of the power consumption. The overall consumption in actual operation will be less than the number provided in the analysis because the average headways on the routes will be slightly larger than the minimum.

Passenger level of service information for this alternative is summarized in Attachment C. An APM system-only capital cost summary for all alternatives is provided in Attachment D. A power demand and consumption analysis is provided in Attachment E.



Lea+Elliott	0 400' 800' 1600'		LAX Master Plan/ EIR/ EIS	Alternative C APM Alignment Figure 3

Alternative C APM Alignment

Figure 3

APM System Description

Two Systems

- Dual-Lane Pinched Loop for secure and sterile passengers
  - Underground
  - Connects between RAC/LTP and TBIT
  - Center/Side Platforms
  - Two Routes
    - Sterile Route for International Arrivals Passengers
      - Center Platform Stations
      - Connects Midfield Concourses to FIS facilities
    - Secure Route
      - Side Platform Stations
      - Connects Midfield Concourses to TBIT and WT
- Dual-lane Pinched Loop for non-secure Passengers w/CTA Circulator
  - Underground West of TBIT/Elevated around Airside of CTA
  - Connects WT Development, Midfield Concourses, RAC, LTP and CTA
  - Center Platforms
  - Two Routes
    - Pinched Loop and Circulator

Passenger Service Characteristics

Non-Secure Trains stop at Midfield Concourses/ Passenger clear security in Midfield Concourses

Provides Passenger Circulation in CTA

Provides Connection between CTA and WT Development/RAC

Frequent/Direct Service

4.0 Future Conditions and Project Impacts

4.1 APM Alternatives Phasing Issues

There are several issues that require consideration in the phasing of the APM systems. These include:

1) APM System Operational Issues
2) APM Facility Issues
3) Constructibility
4) Coordination with Airport Facility Phasing
5) Ability to Meet Level of Service Goals

The following is a description of the APM phasing issues with respect to the three airport alternatives.

4.1.1 Alternative A

The entire APM alignment for Alternative A will be built by 2015. The issues to be considered in the construction of this alignment include coordination with the construction of the airfield and related infrastructure, the West Terminal, the Mid-field Concourse, the East Concourse, and the West Parking Complex. Also, since the alignment goes under the concourse adjacent to the TBIT, there will be some disruption at the TBIT during the construction. These impacts will need to be considered in light of the overall airport level of service issues and timing with other construction and peak airport activity levels.

4.1.2 Alternative B

The entire APM system including both the sterile and non-secure alignments for Alternative B will be built by 2015. The issues to be considered in the construction of these alignments include coordination with the construction of the airfield and related infrastructure, the West Terminal, the Mid-field Concourse, the East Concourse, the West Parking Complex, and the Long-Term Parking/Car Rental facility. In addition, since the alignment goes under the west face of the TBIT there will be some disruption at the TBIT during construction. These impacts will need to be considered in light of the overall airport level of service issues and timing with other construction and peak airport activity levels.

4.1.3 Alternative C

The entire APM system for Alternative C consists of two alignments: a non-secure alignment and a secure/sterile alignment. The non-secure alignment travels from the Long-Term Parking/Rental Car facility in the southwest corner of the airport through the West Terminal, the East and West Mid-field Concourses, the TBIT, and around the CTA. The secure/sterile alignment from the West Terminal, through the East and the West Mid-field concourses to the TBIT. Both alignments will be built by 2015. The issues to be considered in the construction of these alignments include coordination with the construction of the airfield and related infrastructure, the West Terminal, the West Mid-field Concourse, the East Mid-field Concourse, the West Parking Complex, and the Long-Term Parking/Car Rental facility. In addition, since the alignment goes under the TBIT and along the airside face of the CTA terminals, there will be significant disruption to the CTA Terminals and the TBIT during construction. These impacts will need to be considered in light of the overall airport level of service issues and timing with other construction and peak airport activity levels.

5.0 On-Airport Ground Access Plan

5.1 APM Alternatives Evaluation Criteria and Assessment

The following criteria have been used in the evaluation and assessment of the APM alternatives.

Ridership
- Number of Riders
- Rider Groups Served

Passenger Level of Service
- Directness of Trip
- Trip Time
- Frequency of Service
- Clarity/Ease of Use

Capital Cost
- Length of Guideway
- Number of Stations
- Fleet Size
- Elevated/At-Grade/Underground
- Number of Switches

Operational Characteristics
- Operational Efficiency
- System/Route Capacity
- Failure Management
- Operational Flexibility

Construction Issues
- Constructibility
- Phased Implementation Potential
- Impact on Airport Operations
- Expansion Potential

Environmental Mitigation
- Air Quality Benefits
- Roadway Congestion Mitigation

The following is a qualitative assessment of the three APM alternatives based on the evaluation criteria using the results of our analysis. The list of evaluation criteria above has generally been used in the assessment of the alternatives; however, a more detailed evaluation should be conducted after the quantitative and engineering feasibility issues are better defined.

5.1.1 Alternative A

The Alternative A APM system provides a non-secure connection for passengers, employees, and visitors between the TBIT, the East Concourse, the Mid-field Concourse, and the West Terminal Complex. Since all of the riders have been combined onto a single route, it is planned that each train will consist of seven cars. The requirement for the entrainment of more than four cars may reduce the number of system suppliers that can meet the passenger demand. The additional train length will also significantly impact the overall length of the passenger stations. The frequency of service for all classes of passengers is identical since all passengers share the same trains. The passenger service provided to International Arrivals Passengers is degraded because International Arrivals Passengers must clear customs at the Concourse where their flight arrives prior to accessing the non-secure trains. In addition, the passenger service to Domestic Transferring (secure) Passengers is degraded because passengers arriving must leave the secure area before accessing the non-secure trains, and if transferring, these passengers must re-enter the secure area prior to boarding a flight.

The average trip time for this Alternative is less than 4 minutes.

There is no APM access within the CTA in this alternative. The overall passenger connect times including walk times to CTA Terminals should be considered in future assessment of this alternative.

The Alternative A APM offers environmental mitigation over roadway based alternatives in that APMs contribute to reducing roadway based congestion and provide air quality benefits over conventional shuttle bus alternatives since they are electrically powered and therefore are non-emitting.

5.1.2 Alternative B

The Alternative B APM system provides a non-secure connection for passengers and employees between the Long-Term Parking/Rental Car facility, the West Terminal, the Mid-field Concourse, the East Concourse, and the TBIT. In addition, the APM system provides a sterile connection between the West Concourse, the Mid-field Concourse, the East Concourse, and the TBIT. As a result of the heavy passenger demand on the non-secure route, it is planned that each non-secure train will consist of six cars. The requirement for the entrainment of more than four cars may reduce the number of system suppliers that can meet the passenger demand. The additional train lengths will also significantly impact the overall station length. The passenger service provided to International Arrivals Passengers is improved compared to Alternative A because International Arrivals Passengers do not need to clear customs at the Concourse where their flight arrives prior to accessing the trains. Passenger service to Domestic Transferring (secure) Passengers is degraded because passengers arriving must leave the secure area before accessing the non-secure trains.

The average trip time for sterile passengers is less than 3 minutes, and for non-secure passengers the average trip time is less than 4 minutes. There is no APM access within the CTA. The overall passenger connect times including walk times to CTA Terminals should be considered in future assessment of this alternative.

The capital cost for this alternative is higher than Alternative A because of the separation of the sterile and non-secure passengers onto separate alignments.

The environmental mitigation offered by Alternative B is approximately equivalent to Alternative A.

5.1.3 Alternative C

The Alternative C APM system provides a non-secure connection for passengers and employees within the CTA, and to the TBIT, the East Concourse, the West Concourse, the West Terminal, and the Long-Term Parking/Car Rental facility. The APM system also provides a connection for secure and sterile passengers between the TBIT, the East Concourse, the West Concourse, and the West Terminal.

In this alternative, the non-secure, secure, and sterile passengers are separated into separate routes. This has reduced the ridership on each of the two alignments (non-secure/circulator and secure/sterile) to the level where the maximum length train is four cars and therefore will not restrict the technologies that can satisfy this passenger demand. In addition, the planned station length will not be impacted in this alternative.

The average trip time on the secure/sterile alignment is less than 4 minutes. The average trip time on the non-secure route is less than 7 minutes, and the average trip time on the circulator is just over 7 minutes. The non-secure trip times on this route are slightly longer than in the other alternatives, but this alternative serves areas that are not served in Alternatives A or B.

The capital cost for this Alternative is significantly higher than either Alternative A or B due to the separation of the secure and non-secure routes and the extension of the guideway into the CTA.

The alignment in the CTA provides direct access to all terminals in the CTA, so therefore the walk distances to the terminals are shorter than the other two alternatives. Since the ridership in the CTA is low, this feature provides only a slight benefit over the other two alternatives. However, the overall passenger connection times including the walk time should be considered in future assessment of the alternatives.

The environmental mitigation offered by this alternative is better than Alternatives A and B because more riders are served that would otherwise need to be served by another roadway based mode. Therefore, this alternative offers benefits over Alternatives A and B APMs in terms of its contribution to reducing roadway-based congestion and potential of air quality benefits.

LAX Master Plan Phase III

APM Concepts

Ridership Analysis

Attachment A

REFERENCE: 1. JKH Mobility Services Memorandum dated November 22, 1999 to Keith Wilschetz entitled "APM Ridership Trip Data for Alternative 4"

2. JKH Mobility Services Memorandum dated December 20, 1999 to Keith Wilschetz entitled "APM Ridership Trip Data for Alternative 1 and 3"

3. Hirsch Associates Memorandum dated August 28. 1996 to Bruce Anderson entitled "LAX Master Plan: Passenger Surge Factors for APM Sizing"*

The attached diagrams depict the unsurged system link loads and the station boarding and deboarding populations that were developed by JKH Mobility Services and transmitted to Lea+Elliott, Inc., in the above reference documents 1 and 2. It should be noted that the names of the alternatives have been changed from the names used in the referenced JKH documents. Alternative 1 is now called Alternative A, Alterative 3 is now called Alternative B, and Alternative 4 is now referred to as Alternative C.

In the cases of Alternatives A and B, Lea+Elliott has applied surge factors to the links where surge factors would be appropriate as described in the Hirsch Associates memo, reference document 3. It is Lea+Elliott's understanding that the gating assumptions developed by Hirsch Associates for the Phase II work have not changed and therefore the surge assumptions used in Phase II remain valid for the Phase III APM Modeling. As you can see from the attached diagrams, the peak link is typically in the inbound direction between the West Airside Concourse or Midfield Concourse and the West Terminal. The data provided by JKH provides detailed information about the origin station and destination station for each APM passenger.

In the case of Alternative C, the data provided by JKH did not include non-secure APM stations at the midfield concourses. Because of this, passengers who wish to travel from the Long Term Parking/Rental Car station to the midfield concourses would be required to travel on the non-secure system between the LTP/RAC station and the West Terminal station, then transfer to the secure system and travel to the midfield concourses. Lea+Elliott was able to determine the number of passengers that would make this connection based on the information provided by JKH. Lea+Elliott subtracted the appropriate number of passengers from the secure system and placed them onto the non-secure system to account for these passengers. The proper surge factors were then applied to determine the maximum expected number of riders using the system at the peak times.

The resulting peak link demand is as shown in Table 1. The tables and diagrams that follow provide the station boarding and deboarding populations and the link loads for each of the routes for the three alternatives.

For the purpose of determining train performance/operations, we have used the APM peaks as defined in the JKH reference documents in the cases where it was available since the demand is higher during the APM peak than the Airport peak in these particular cases. Fleet requirements for each of the three alternatives have been calculated based on the passenger demand requirements and are included in Table 2 of Attachment B.

*The following information has been excerpted from Reference 3 to clarify the assumption about the surge factors.

The following peak 20 minute concentrations were used in Hirsch Associates Terminal Capacity Analysis for the existing CTA. The basis of the concentrations was an analysis of the 1994 Design Day Schedule with passengers as assigned by L&B, and some Hirsch Associates data from other airports.

Domestic Deplaning Passengers

The following are the percentages of deplaning peak hour passengers, which occur within a peak 20 minute period based on the scheduled arrival time.

T-1	*51%*
T-2	*60%*
T-3	*51%*
T-4	*50%*
T-5	*62%*
T-6	*44%*
T7/8	*42%*
TBIT	*71%*

For the west side terminals, the portion with domestic operations is assumed to be a major US international/ domestic hub similar to T-7/8.

Enplaning Passengers

The following percentages were used to estimate ATO demand and reflect passengers through the "front door". The check-in function may further spread out these peaks if insufficient positions are staffed. The percentages were based on typical domestic and international check-in time distributions. These have not been checked against actual LAX conditions.

Domestic (T-1, 3, 4, 6)	*32%*
Mixed (T-5, 7, 20% int'l)	*28%*
Mixed (T-2, 50% int'l)	*24%*
International (TBIT)	*20%*

For the west side terminals, the activity would be mixed with a strong international component. We suggest using 24% of the peak hour in the peak 20 minute period.

International Arrivals

For smaller terminals (T-2 and T-5), the lower number of flights result in peak hour arrivals being more concentrated than in larger terminals with more peak hour flights (T-7 and TBIT). It has been estimated that the peak 20 minutes accounts for 70% of the peak hour passengers in smaller terminals and 50% in larger terminals. For future conditions, especially in new terminals on the west side, a 50% concentration is suggested for passenger flows entering a sterile APM to connect with a landside FIS (Terminal Option 2). However, the FIS processing function will dilute the flows exiting the FIS and boarding an APM from a remote airside FIS to a landside curb. Without modeling this, we would estimate that the surge factor would drop to a negligible number, or just enough to feel comfortable with typical random variations in passenger flows.

Two significant observations made in this excerpt have helped to define surge factors used in the preparation of the passenger demand estimates. The first: *"For the west side terminals, the portion with domestic operations is assumed to be a major US international/ domestic hub similar to T-7/8."* helps to define the surge factor for west side terminals. The second: *"It has been estimated that the peak 20 minutes accounts for 70% of the peak hour passengers in smaller terminals and 50% in larger terminals."* defines the surge factor for the secure international arrivals. The first note indicates that the west side terminals are likely to generate surges similar to T-7/8. T-7/8 generates 42% of the activity in the busiest 20 minutes of the peak hour. This is equivalent to a surge factor for transferring passengers of about 126%. The second note indicates that large international operations generate about 50% of the demand for the peak hour in the busiest 20 minutes. This is equivalent to a surge factor of about 150%. These surge factors have been applied to the appropriate populations of the JKH data to determine the peak system passenger demand. A summary of the peak passenger demand is provided here in Table 1.

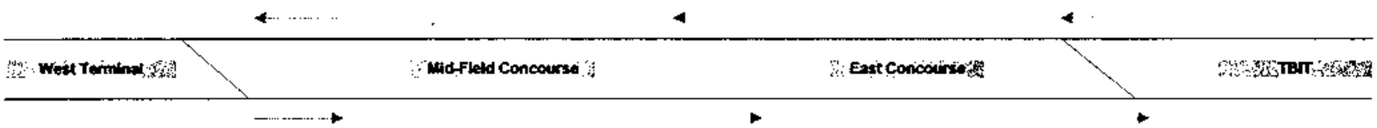
Table 1:

PEAK LINK RIDERSHIP SUMMARY

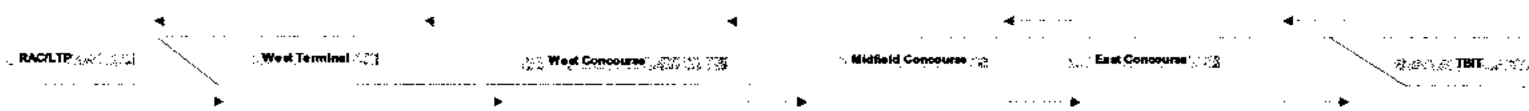
Alternative	Route	Hour	Surged Peak Link
A	Non-secure	12:00 - 1:00 PM	10285
B	Non-secure	12:00 - 1:00 PM	8701
B	Sterile	12:00 - 1:00 PM	4911
C	Non-secure	11:00 - 12:00 AM	2381
C	Secure	12:00 - 1:00 PM	3997
C	Sterile	12:00 - 1:00 PM	4200
C	Circulator	2:00 - 3:00 PM	119

Alternative A – Non-Secure Route

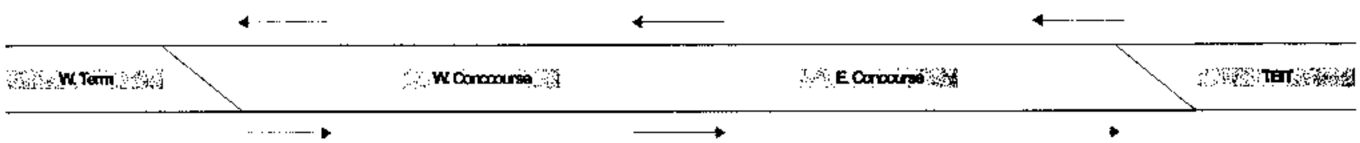
Alternative B - Sterile Route



Alternative B – Non-Secure Route

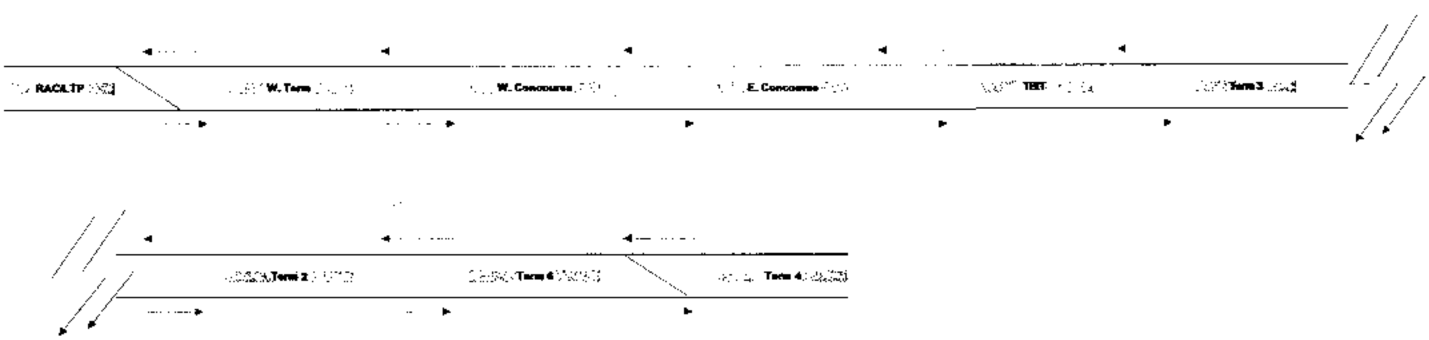


Alternative C – Secure Route

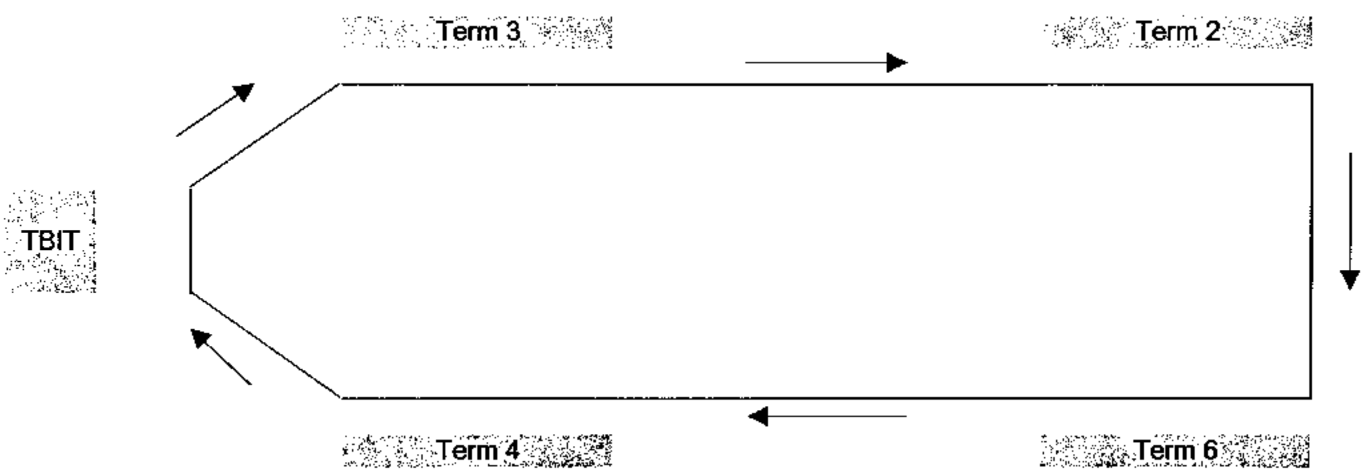


Alternative C – Sterile Route

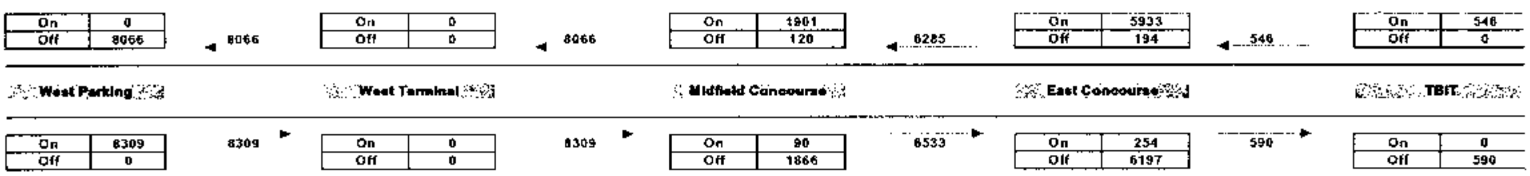
Alternative C – Non Secure Route



Alternative C – Secure Route

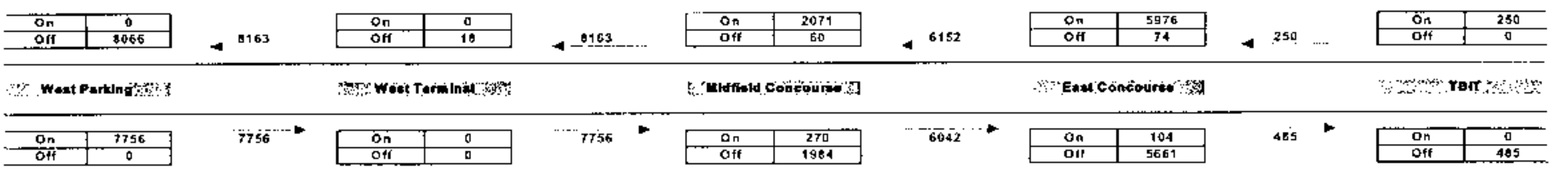


Alternative A -- Non-Secure Route (Year 2015)
11:00 AM 12:00 PM Eastbound APM Peak Hour (Unsurged)



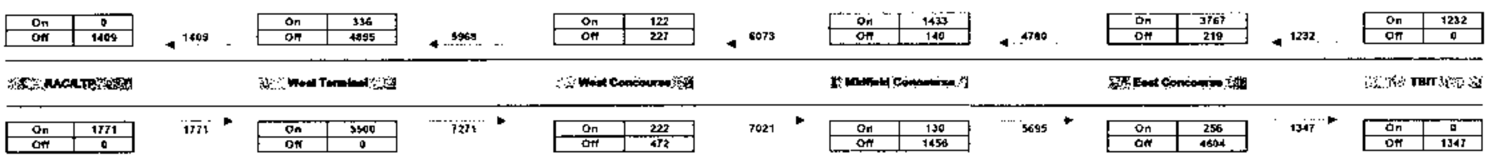
Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Inbound to W. Term	W. Term to RAC/LTP	8066	126%	10163
Outbound from W. Term	W. Term to W. Conc	8309	100%	8309

Alternative A – Non-Secure Route (Year 2015)
12:00 – 1:00 PM Eastbound APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Inbound to W. Term	W. Term to RAC/LTP	8163	126%	10285
Outbound from W. Term	W. Term to W. Conc	7756	100%	7756

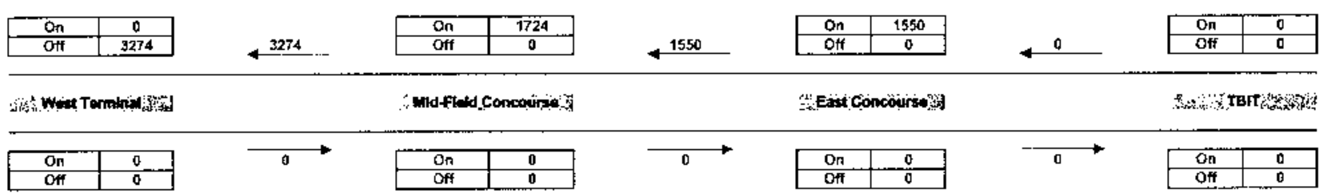
Alternative B – Non-Secure Route (Year 2015)
12:00 -- 1:00 PM APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %		Surged Total
Inbound to W. Term	W. Term to RAC/LTP	6073	126%		7652
Outbound from W. Term	W. Term to W. Conc	7271	120%	See Note	8701

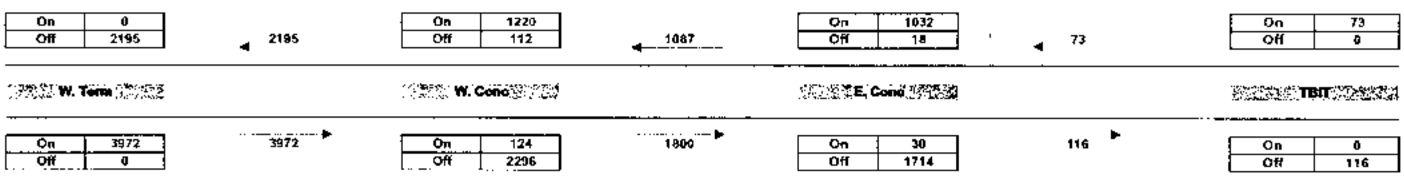
Note: Surge Factor of 126% is applied to passengers originating in the West Terminal. RAC/LTP Passengers are not surged

Alternative B – Sterile Route (Year 2015)
12:00 - 1:00 PM APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Inbound to W. Term	W. Term to RAC/LTP	3274	150%	4911
Outbound from W. Term	W. Term to W. Conc	0	100%	0

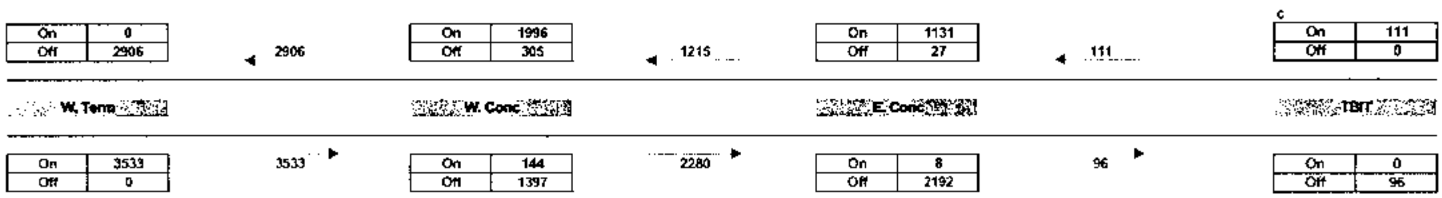
Alternative C – Secure Route (Year 2015)
12:00 – 1:00 PM Eastbound APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %		Surged Total
Inbound to W. Term	W. Conc to W. Term	2195	126%		2766
Outbound from W. Term	W. Term to W. Conc	3972	101%	See Note	3997

Note: There are only 97 transferring passengers during this hour on the peak link. These are surged at 126%

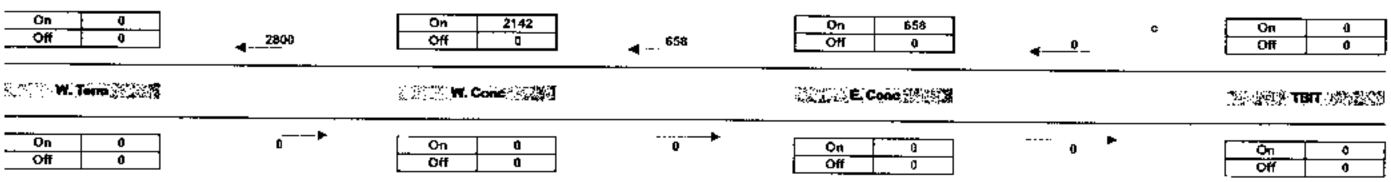
Alternative C – Secure Route (Year 2015)
2:00 – 3:00 PM Westbound APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %		Surged Total
Outbound from W. Term	W. Term to W. Conc	2906	126%		3662
Inbound to W. Term	W. Conc to W. Term	3533	102%	See Note	3594

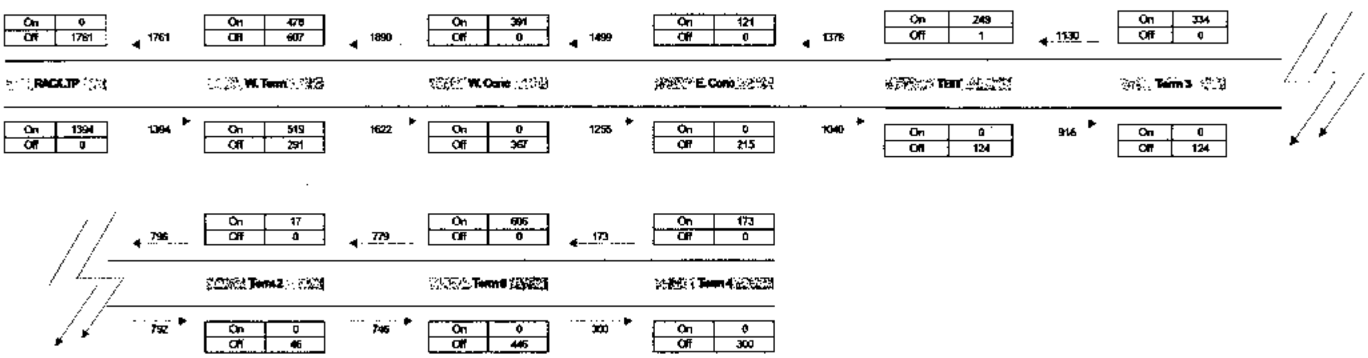
Note: There are only 233 transferring passengers during this hour on the peak link. These are surged at 126%

Alternative C – Sterile Route (Year 2015)
12:00 – 1:00 PM Eastbound APM Peak Hour (Unsurged)



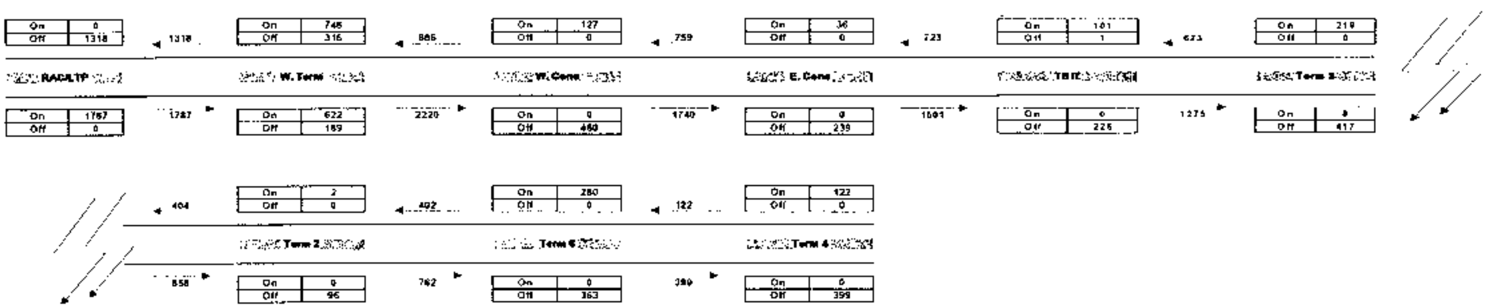
Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Outbound from W. Term	W. Term to W. Conc	0	100%	0
Inbound from W. Term	W. Conc to W. Term	2800	150%	4200

Alternative C – Non-Secure Route (Year 2015)
11:00 AM – 12:00 PM Westbound APM Peak Hour (Unsurged)



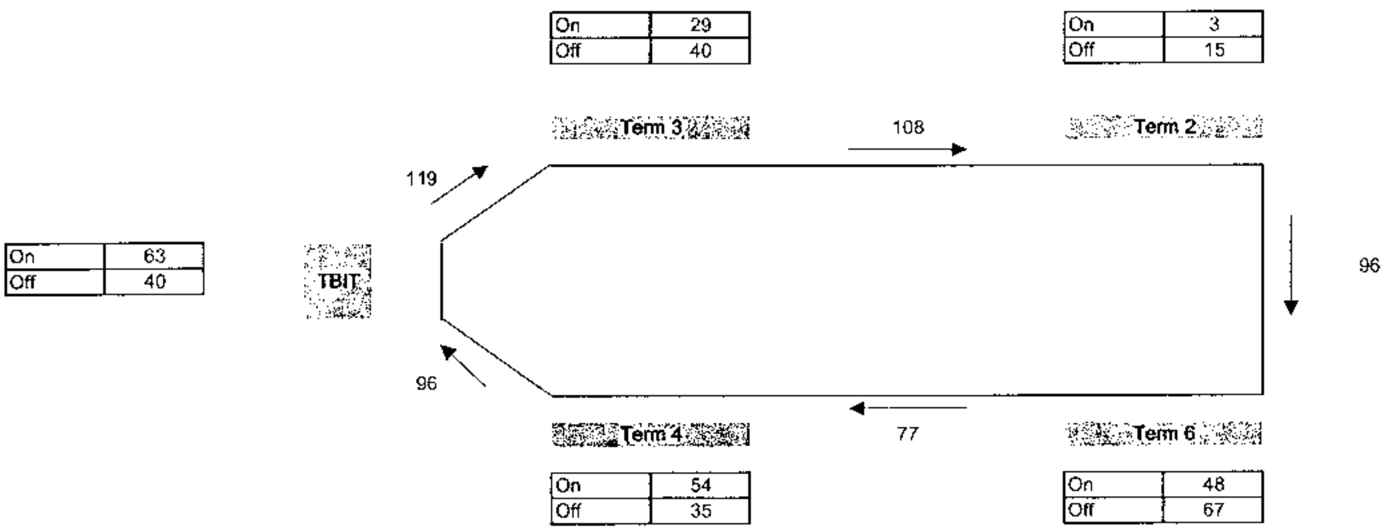
Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Inbound to W. Term	W. Term to RAC/LTP	1890	126%	2381
Outbound from W. Term	W. Term to W. Conc	1622	100%	1622

Alternative C – Non-Secure Route (Year 2015)
12:00 – 1:00 PM Eastbound APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Inbound to W. Term	W. Term to RAC/LTP	1318	120%	1661
Outbound from W. Term	W. Term to W. Conc	2220	100%	2220

Alternative C – Circulator Route (Year 2015)
1:00 – 2:00 PM Circulator APM Peak Hour (Unsurged)



Direction	Peak Link	Unsurged Total	Surge Factor %	Surged Total
Clockwise	TBIT to Term 3	119	100%	119

LAX Master Plan Phase III

APM Concepts

Train Performance Modeling

Attachment B

The tables provided in this appendix provide the results of the train performance modeling analysis. The following assumptions were used to prepare the models.

1. Maximum passenger wait time: 8 minutes

2. Minimum Headway for combined routes: 114 seconds

3. Minimum Headway for single routes: 100 seconds

4. Maximum train consist: 7 cars.

5. Capacity per car:
   Passengers with carry-on baggage only: 67 passengers per car.
   Passengers with all baggage (Non-secure route): 55 passengers per car.

6. Alternative B International Arrivals Passengers ride sterile APM system to access the FIS facilities in the West Terminal and the TBIT.

7. For Alternative C, to maximize passenger service, non-secure and secure passengers will be transported on separate trains since not all stations serve non-secure and secure passengers.

The results of the analysis have helped to identify strengths and weaknesses of the various Alternatives.

Alternative A - The ridership and system performance analyses for this alternative have indicated that train lengths of seven cars will be necessary to serve the passenger demand at peak times. The requirement for trains of this length may have the undesirable effect of limiting the types of vehicle technologies that can satisfy the performance requirements of this option. This option is the simplest option requiring the least amount of system hardware, but this option also provides the lowest level of passenger service. Passenger service is poor in this option because transferring passenger will be required to exit the secure or sterile area before they are permitted to board the trains.

Alternative B - The ridership and system performance analyses for this alternative have indicated that train lengths of six cars on the non-secure route will be necessary to serve the passenger demand at peak times. The requirement for trains of this length may have the undesirable effect of limiting the types of vehicle technologies that can satisfy the performance requirements of this option. This option, while more complex, provides a higher level of service to International Arrivals Passengers. Domestic transferring passengers are still required to exit the secure area to board the trains as in Alternative A.

Alternative C - In this option, the passenger populations are segregated into groups that are served by separate APM routes. In addition, this option provides APM service to the CTA that is not provided in the other two alternatives. The passenger level of service is the highest in this alternative. The longest train required for this alternative is a four-car train on the combined secure/sterile route. Trains of this length can be provided by several system suppliers and are not expected to limit technology options. This alternative is the most complex option requiring significantly more hardware and infrastructure to satisfy the passenger demand.

Table 2:
LAX MASTER PLAN PHASE III APM TRAIN PERFORMANCE MODELING ALTERNATIVES

Alternative A	Non-Secure Route
Peak Link Demand	10285
Capacity Provided	10913
Number of Trains/Cars	5, 7-car
Headway	127 seconds
Trains/Hour	28
Capacity/Car	55
Load Factor	94%
Operational Fleet	35 cars
Total Fleet	42 cars

Alternative B	Non-Secure Route	Sterile Route
Peak Link Demand	8701	4911
Capacity Provided	9581	5835
Number of Trains/Cars	7, 6-car	4, 3-car
Headway	124 seconds	124 seconds
Trains/Hour	29	29
Capacity/Car	55	67
Load Factor	91%	84%
Operational Fleet	42 cars	12 cars
Total Fleet	64 cars	

Alternative C	Non-Secure Route		Sterile Route	Secure	Circulator	
Peak Link Demand	2381	2381	4200	3997	119	119
Capacity Provided	2475	2640	4232	4232	413	330
Number of Trains/Cars	12, 2-car	16, 2-car	5, 2-car	5, 2-car	1, 1-car	1, 1-car
Headway (nom) *	160	150	114	114	480	600
Trains/Hour	22.5	24	32	32	8	8
Capacity/Car	55	55	67	67	55	55
Load Factor	96%	90%	99%	94%	29%	36%
Operational Fleet	24 cars	32 cars	10 cars	10 cars	1 car	1 car
Total Fleet	55/64 cars					

Note: * Minimum headway is the shortest separation between cars. Nominal headway accounts for eccentric spacing between trains to facilitate overlapping route in the CTA.

LAX Master Plan Phase III

APM Concepts

Passenger Trip Times

Attachment C

The following documentation provides the station to station passenger trip times on the APM routes for each of the three Alternatives A, B, and C. Schematic route diagrams and station names are provided for reference. The routes are described as follows:

Alternative A - One Route Only

The non-secure route is a pinched-loop route which connects the TBIT and the West Terminal. This route serves five stations located at the West Parking, the West Terminal, the Mid-field Concourse, the East Concourse, and the TBIT.

Alternative B- Two Routes

Route 1 is a non-secure route that operates as a pinched loop on a separate dual-lane alignment from route 1. This route connects six stations located at the RAC/LTP, the West Terminal Parking, the West Concourse, the East Concourse, and the TBIT.

Route 2 is a sterile route that operates as a pinched loop. This route connects four stations located at the West Terminal, the Mid-field Concourse, the East Concourse, and the TBIT.

Alternative C- 4 Routes

Route 1 is a non-secure route that operates as a pinched loop. This route connects nine stations located at the RAC/LTP, the West Terminal, the West Midfield Concourse, the East Midfield Concourse, the TBIT, Terminal 3, Terminal 2, Terminal 6, and Terminal 4.

Route 2 is a sterile route that operates as a pinched loop. This route connects four stations located at the West Terminal, the West Midfield Concourse, the East Midfield Concourse, and the TBIT. This route operates on the same guideway as the secure route described below. In addition, this route shares trains with the secure route where two trains of the four-car train dedicated to secure service and two trains of the four-car train dedicated to sterile service.

Route 3 is a secure route that operates as a pinched loop. This route connects four stations located at the West Terminal, the West Midfield Concourse, the East Midfield Concourse, and the TBIT. This route operates on the same guideway as the sterile route described above. In addition, this route shares trains with the sterile route where two trains of the four-car train dedicated to secure service and two trains of the four-car train dedicated to sterile service.

Route 4 is a non-secure route that operates as a true loop that circulates within the CTA. This route connects five stations located at the TBIT, Terminal 3, Terminal 2, Terminal 6, and Terminal 4. This route shares the inner guideway lane and some of the stations located within the CTA used by the non-secure pinched-loop route.

The overall maximum and average passenger trip times for each alternative and route are reported in the tables on the following page of this attachment. Subsequent pages report the passenger trip times for trips between each station pair on each route within the alternatives. It has been assumed that the passengers will be provided with signage directing them to use the routes that will provide the shortest trip times between their origins and destinations.

ALTERNATIVE A - NON-SECURE TRIP TIME

INPUTS:

Round Trip Time (sec):	635
Headway (sec):	127
Average Wait (sec):	63.5
Dwell (sec):	30
Speed (mph):	45

Alternative A - Non-Secure Trip Times (sec)

	WP	WT	MF	EC	TBIT
WP		100	245	323	410
WT	103		119	197	284
MF	188	119		112	199
EC	267	198	113		120
TBIT	352	283	198	119	

Alternative A - Non-Secure Trip Times (min)

	WP	WT	MF	EC	TBIT
WP		2.7	5.1	6.4	7.9
WT	2.8		3.0	4.3	5.8
MF	4.2	3.0		2.9	4.4
EC	5.5	4.4	2.9		3.1
TBIT	6.9	5.8	4.4	3.0	

Alternative A - Maximum Trip Time (min):	7.9
Alternative A - Average Trip Time (min):	3.4

ALTERNATIVE B - NON-SECURE TRIP TIME

INPUTS:

Round Trip Time (sec):	867
Headway (sec):	124
Average Wait (sec):	62
Dwell (sec):	30
Speed (mph):	50

Alternative B - Non-Secure Trip Time (sec)

	RAC	WT	WC	MF	EC	TBIT
RAC		151	256	329	409	490
WT	164		106	180	259	340
WC	238	96		106	185	266
MF	311	180	106		111	192
EC	391	259	185	112		113
TBIT	472	340	266	192	113	

Alternative B - Non-Secure Trip Time (min)

	RAC	WT	WC	MF	EC	TBIT
RAC		3.6	5.3	6.5	7.8	9.2
WT	3.8		2.8	4.0	5.4	6.7
WC	5.0	2.6		2.8	4.1	5.5
MF	6.2	4.0	2.8		2.9	4.2
EC	7.5	5.4	4.1	2.9		2.9
TBIT	8.9	6.7	5.5	4.2	2.9	

Alternative B - Non-Secure- Maximum Trip Time (min):	9.2
Alternative B - Non-Secure- Average Trip Time (min):	3.8

ALTERNATIVE B - STERILE TRIP TIME

INPUTS:

Round Trip Time (sec):	496
Headway (sec):	124
Average Wait (sec):	62
Dwell (sec):	30
Speed (mph):	45

Alternative B - Sterile - Trip Time (sec)

	WT	MF	EC	TBIT
WT		120	229	310
MF	121		111	192
EC	200	111		113
TBIT	280	192	112	

Alternative B - Sterile - Trip Time (min)

	WT	MF	EC	TBIT
WT		2	4	5
MF	2		2	3
EC	3	2		2
TBIT	5	3	2	

Alternative B - Sterile - Maximum Trip Time (min)	6.2
Alternative B - Sterile - Average Trip Time (min)	2.9

ALTERNATIVE C - SECURE TRIP TIMES

INPUTS:

Round Trip Time (sec):	568 sec.
Headway (sec):	114 sec.
Average Wait (sec):	57 sec.
Dwell (sec):	30 sec;
Speed (mph):	30 mph

Alternative C - Secure - Trip Time (sec)

	WT	WMC	EMC	TBIT E
WT		108	250	343
WMC	51		140	232
EMC	402	140		119
TBIT E	309	434	116	

Alternative C - Secure - Trip Time (min.)

	WT	WMC	EMC	TBIT E
WT		2.7	5.1	6.7
WMC	1.8		3.3	4.8
EMC	7.6	3.3		2.9
TBIT E	6.1	8.2	2.9	

Alternative C - Secure - Maximum Trip Time (min)	8.2 min.
Alternative C - Secure - Average Trip Time (min)	3.7 min.

ALTERNATIVE C - STERILE TRIP TIMES

INPUTS:

Round Trip Time (sec):	568 sec.
Headway (sec):	114 sec.
Average Wait (sec):	57 sec.
Dwell (sec):	30 sec.
Speed (mph):	30 mph

Alternative C - Sterile - Trip Time (sec)

	WT	WMC	EMC	TBIT E
WT		108	250	343
WMC	51		140	232
EMC	402	140		119
TBIT E	309	434	116	

Alternative C - Sterile - Trip Time (sec)

	WT	WMC	EMC	TBIT E
WT		2.7	5.1	6.7
WMC	1.8		3.3	4.8
EMC	7.6	3.3		2.9
TBIT E	6.1	8.2	2.9	

Alternative C - Sterile - Maximum Trip Time (min):	8.2 min.
Alternative C - Sterile - Average Trip Time (min):	3.7 min.

ALTERNATIVE C - NON-SECURE - TRIP TIME (sec)

	RAC	WT	WMC	EMC	TBIT N	T3	T2	T6	T4
RAC		264	400	558	691	819	946	1123	1273
WT	266		211	369	502	630	757	934	1084
WMC	407	217		233	366	494	621	798	947
EMC	565	375	233		208	336	463	640	789
TBIT N	690	500	358	200		202	330	507	656
T3	828	637	495	337	212		202	379	529
T2	955	764	622	464	339	202		252	402
T6	1137	946	804	647	522	384	257		225
T4	1277	1086	945	787	662	524	397	215	

ALTERNATIVE C - NON-SECURE - TRIP TIME (min)

	RAC	WT	WMC	EMC	TBIT N	T3	T2	T6	T4
RAC		4.4	6.7	9.3	11.5	13.6	15.8	18.7	21.2
WT	4.4		3.5	6.2	8.4	10.5	12.6	15.6	18.1
WMC	6.8	3.6		3.9	6.1	8.2	10.3	13.3	15.8
EMC	9.4	6.2	3.9		3.5	5.6	7.7	10.7	13.2
TBIT N	11.5	8.3	6.0	3.3		3.4	5.5	8.4	10.9
T3	13.8	10.6	8.3	5.6	3.5		3.4	6.3	8.8
T2	15.9	12.7	10.4	7.7	5.7	3.4		4.2	6.7
T6	18.9	15.8	13.4	10.8	8.7	6.4	4.3		3.7
T4	21.3	18.1	15.7	13.1	11.0	8.7	6.6	3.6	

Alternative C - Non-Secure - Maximum Trip Time (min) 24.0 min.
Alternative C - Non-Secure - Average Trip Time (min) 9.4 min.

Note: The minimum headway between successive trains is 120 seconds, but since the circulator serves a different population the effective average headway for this route is 150 sec.

ALTERNATIVE C - CIRCULATOR TRIP TIME

INPUTS:

Round Trip Time (sec):	600 sec.
Headway (sec):	600 see note
Average Wait (sec):	300 sec.
Dwell (sec):	66.6 sec.
Speed (mph):	30 mph

Alternative C - Circulator - Trip Time (sec)

	T3	T2	T6	T4	TBIT E
T3		406	555	680	783
T2	794		449	574	678
T6	645	751		426	529
T4	520	625	774		403
TBIT E	416	522	671	797	

Alternative C - Circulator - Trip Time (min)

	T3	T2	T6	T4	TBIT E
T3		6.8	9.2	11.3	13.1
T2	13.2		7.5	9.6	11.3
T6	10.8	12.5		7.1	8.8
T4	8.7	10.4	12.9		6.7
TBIT E	6.9	8.7	11.2	13.3	

Alternative C - Circulator - Maximum Trip Time (min)	18.3 min.
Alternative C - Circulator - Average Trip Time (min)	10.0 min.

Note: The minimum headway for this route is 480 sec. To synchronize operation with the Non-secure route and reduce load factor, the actual system headway is 600 seconds.

LAX Master Plan Phase III

APM Concepts

System Capital Cost Estimate

Attachment D

LAX (PHASE III) AUTOMATED PEOPLE MOVER
SYSTEM COST ESTIMATE

YEAR 2015, (2000 $)

SUBSYSTEM COST SUMMARY	ALTERNATIVE A	ALTERNATIVE B	ALTERNATIVE C
GUIDEWAY SURFACES AND EQUIPMENT	$ 14,099,000	$ 28,327,000	$ 43,518,000
STATION FACILITIES AND EQUIPMENT	$ 12,502,000	$ 22,423,000	$ 17,811,000
MAINTENANCE AND STORAGE FACILITY	$ 8,290,000	$ 10,705,000	$ 10,705,000
POWER DISTRIBUTION SYSTEM (PDS)	$ 10,806,000	$ 16,113,000	$ 25,404,000
VEHICLES	$ 65,594,000	$ 99,671,000	$ 99,671,000
COMMAND, CONTROL, AND COMMUNICATIONS	$ 13,746,000	$ 27,778,000	$ 42,957,000
EXPENDABLE PARTS AND SPARE EQUIPMENT	$ 5,959,000	$ 9,080,000	$ 9,080,000
OTHER SYSTEM FACILITIES/EQUIPMENT	$ 1,891,000	$ 3,079,000	$ 4,268,000
OPERATING SYSTEM VERIFICATION AND ACCEPTANCE	$ 2,027,000	$ 2,027,000	$ 2,027,000
PROJECT MANAGEMENT	$ 19,994,000	$ 41,528,000	$ 64,867,000
SUB-TOTAL	$ 154,908,000	$ 260,731,000	$ 320,308,000
CONTINGENCY (25%)	$ 38,727,000	$ 65,183,000	$ 80,077,000
TOTAL (Year 2000 Dollars)	$ 193,635,000	$ 325,914,000	$ 400,385,000

LAX Master Plan Phase III

APM Concepts

Energy Consumption Analysis

Attachment E

ELECTRICAL POWER CONSUMPTION ESTIMATE

FOR

LAX APM CONCEPTS

Prepared for:

LAX MASTER PLAN

TRANSPORTATION PLANNING (PEOPLE MOVER)

Prepared by:

LEA+ELLIOTT, INC.

January 12, 2000

TASK SCOPE

Perform a power-demand analysis to develop an estimate of energy consumption for the three APM system alternatives that are currently being considered for the Los Angeles International Airport (LAX). Alternative A consists of a pinched-loop system with five passenger stations operating a non-secure route. Alternative B consists of two pinched-loop systems: a non-secure system with six passenger stations and a sterile system with four passenger stations. Alternative C consists of three operational routes (sterile/secure passengers segregated on independent vehicles coupled to form a common train) operating on two dual lanes. The estimates are developed from Lea+Elliott LEGENDS© train performance modeling data summarized in the tables and graphs at the end of this attachment. The results provide estimated peak kilowatt demands for the peak period and estimated annual kilowatt-hour consumption requirements of the considered APM systems.

INTRODUCTION

The Alternative A APM configuration analyzed in this report is described below to provide background information for the analysis:

Non-Secure Pinched Loop
- Five Stations with 8 stops (2 turnback + 6 inline),
- 5 7 - Car Trains,
- 635 seconds Round-Trip Time,
- Approximately 13,700 feet of single-lane guideway;

The Alternative B APM configuration analyzed in this report is described below to provide background information for the analysis. The Alternative B APM configuration consists of two independent dual-lane guideways utilized to provide two routes as detailed below:

Non-Secure Pinched Loop
- Six stations - 10 stops (2 turnback + 8 inline),
- 7 6 - Car Trains,
- 867 seconds Round-Trip Time;
- Approximately 20,400 feet of single-lane guideway;

Sterile Pinched Loop
- Four Stations - 6 stops,
- 4 3 - Car Trains,
- 496 seconds Round-trip time;
- Approximately 11,800 feet of single-lane guideway;

The Alternative C APM configuration analyzed in this report is described below to provide background information for the analysis. The Alternative C APM configuration consists of two independent dual-lane guideways utilized to provide four route structures as detailed below:

Route A) - Non-Secure Pinched-Loop Route
- Nine Stations with 16 stops (2 turnback + 14 inline),
- 16 2-Car Trains,
- 1920 seconds Round-Trip Time,
- Approximately 33,700 feet of single-lane guideway;

Route B) - Secure Pinched-Loop Route
- Four stations - 6 stops (2 turnback + 4 inline),
- 5 2-Car Trains (each train coupled with a Route C train),
- 570 sec Round-Trip Time;
- Approximately 11,800 feet of single-lane guideway;

Route C) - Sterile Pinched-Loop Route (same guideway as Route B)
- Four Stations - 6 stops,
- 5 2-Car Trains (each train coupled with a Route B train),
- 570 seconds Round-trip time;
- Approximately 11,800 feet of single-lane guideway;

Route D) - Secure Circulator-Loop Route for the sterile international travelers,
- Five Stations - 5 stops,
- 1 1- Car Train,
- 480 seconds Round-Trip Time,
- Approximately 7,300 feet of single-lane guideway, most of which is on a guideway shared with Route A.

Even though Routes B and C utilize a common train, their passengers must be segregated on independent vehicles. Therefore, in this analysis, they are designated jointly as the Route B | C, secure/sterile route and treated as 5 4 - car trains to facilitate the power demand estimate.

All together, the train peak load service consists of 22 trains and 53 cars in various train configurations. The system capacities and train service requirements for the three loading periods (peak, off-peak, and night) were determined in ridership and performance modeling analyses presented separately.

The power demand analyses were performed using two Lea+Elliott simulation and calculation models: the Train Performance Simulator and the Lea+Elliott Power Demand Summation Model. The train performance simulator produces individual train performance and power demand characteristics on a per second and guideway location basis throughout a single round-trip using a model of the selected train propulsion unit, train length, passenger load, and guideway alignment characteristics. These characteristics govern the trains acceleration, velocity performance, and therefore the train's power demand.

The Power Demand Summation Model accumulates the total simultaneous (also on a per second basis) power demand for all trains operating at a defined headway using the output of the performance simulator. This model produces power (kw) demand for the substations based on the positional and time data for all trains.

In addition to the train propulsion PDS demand data provided above, the model provides estimates of ancillary load requirements such as guideway heating (assumed to be zero for the Los Angeles climate), the system stations ancillary loads, and a generic Maintenance and Storage Facility (M&SF) load to complete the total APM power distribution load predictions for all periods of operations throughout a 24 hour day.

ASSUMPTIONS

The assumptions used in this power analysis are:

1. Train loads (for weight purposes) are assumed to be 80 passengers per vehicle.

2. Headways and cars per train for all alternatives are as described in the introduction.

3. System operation is presumed to be 24 hours per day, 7 days per week, and 365 days per year. There are three distinct operating periods:

   Peak Period operations for 12 hours per day;

Alternative A -	5 7-Car Trains
Alternative B, non-secure -	7 6-Car Trains
Alternative B, sterile -	4 3-Car Trains
Alternative C- Route A -	16 2-Car Trains
Alternative C- Route B+C -	5 4-Car Trains
Alternative C- Route D -	1 1- Car Train

   Off Peak Period operations for 6 hours per day;

Alternative A -	3 7-Car Trains
Alternative B, non-secure	3 6-Car Trains
Alternative B, sterile -	2 3-Car Trains
Alternative C- Route A -	8 2-Car Trains
Alternative C - Route B+C -	3 4-Car Trains
Alternative C - Route D -	1 1-Car Train

   Night operations for 6 hours per day;

Alternative A -	1 7-Car Train
Alternative B, non-secure -	1 6-Car Train
Alternative B, sterile -	1 3-Car Train
Alternative C- Route A -	2 2-Car Trains
Alternative C -Route B+C -	1 4-Car Trains
Alternative C -Route D -	1 1-Car Train

4. Typical Alternating Current (AC) and Direct Current (DC) technologies were modeled.

The attached tables and graphed data provide the results of the Electrical Power Consumption Analyses. For Alternative B analysis purposes, it was assumed that due to the close proximity of the two systems, non-secure and sterile, most of the substations will simultaneously supply power to both systems. Additionally, it was assumed that there would be a substation located at or near each passenger station. For Alternative C analysis purposes, on the non-secure route it was assumed that the trains were operating on the minimum round-trip times rather than the round-trip times which are expanded to accommodate the operation of the circulator and the pinched-loop route sharing parts of the same guideway. Also, for power analysis purposes in Alternative C, the secure and sterile passenger routes, Routes B + C, were treated as four-car trains (2 cars per route). The attached tables and graphed data provide the results of the Electrical Power Consumption Analyses. For analysis purposes, it was assumed that due to the close proximity and shared guideway of the four routes of Alternative C (Routes A, B+C, and D), most of the substations will simultaneously supply power to two systems. Additionally, it was assumed that there would be a substation located at each passenger station (except the one station that is only served by the Non-secure Circulator), nine substations total.

The following ancillary (non-propulsion) loads were estimated:

APM Supplier related station equipment for each station
Maintenance and Storage Facility.

For the power estimate for the Maintenance and Storage Facility, it was assumed that this facility contains the APM suppliers primary office space, Central Control, Central Electronics room, all typical maintenance equipment, six cars without power (undergoing some type of maintenance activity), and one four-car train powered in a ready status.

PEAK AND ANNUALIZED POWER CONSUMPTION ESTIMATES

The RMS and peak power loads for the system feeder and for each of the substations considered are provided in the Appendix. In addition, an annual kw-hr estimate has been provided based on the operating period loading described in the assumptions. It should be noted that the graphs provided are for the peak-load period since it represents the worst case power demand.

For summary reference, the estimated annual kilowatt-hour consumption for each technology is as follows (rounded):

Alternative A

AC - 57,000,000 kw-hr/yr for train propulsion only and
64,200,000 kw-hr/yr for train propulsion plus ancillary loads

DC - 86,000,000 kw-hr/yr for train propulsion only and
93,200,000 kw-hr/yr for train propulsion plus ancillary loads

Alternative B

AC - 108,800,000 kw-hr/yr for train propulsion only and
116,000,000 kw-hr/yr for train propulsion plus ancillary loads

DC - 167,300,000 kw-hr/yr for train propulsion only and
174,500,000 kw-hr/yr for train propulsion plus ancillary loads

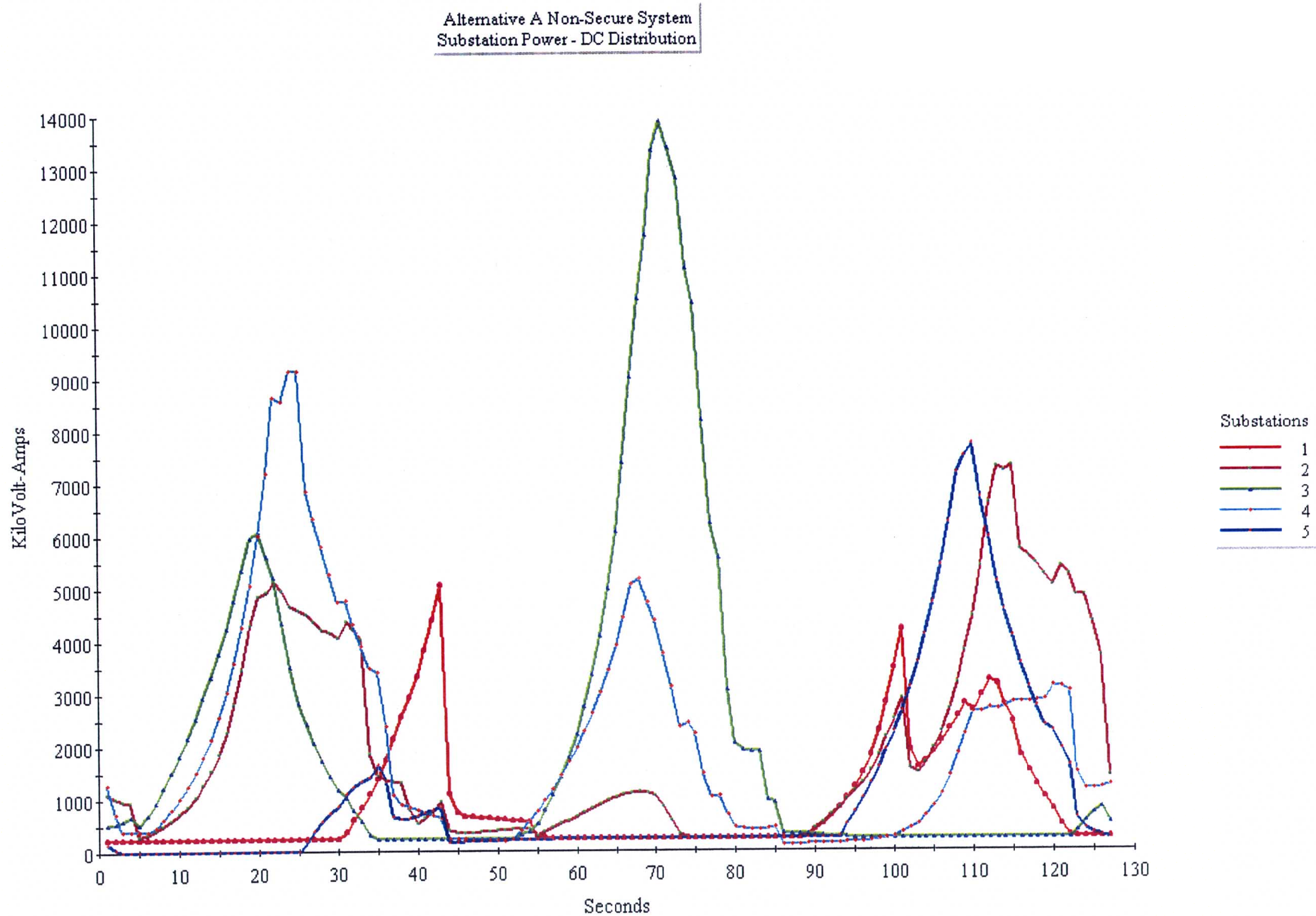
Alternative C

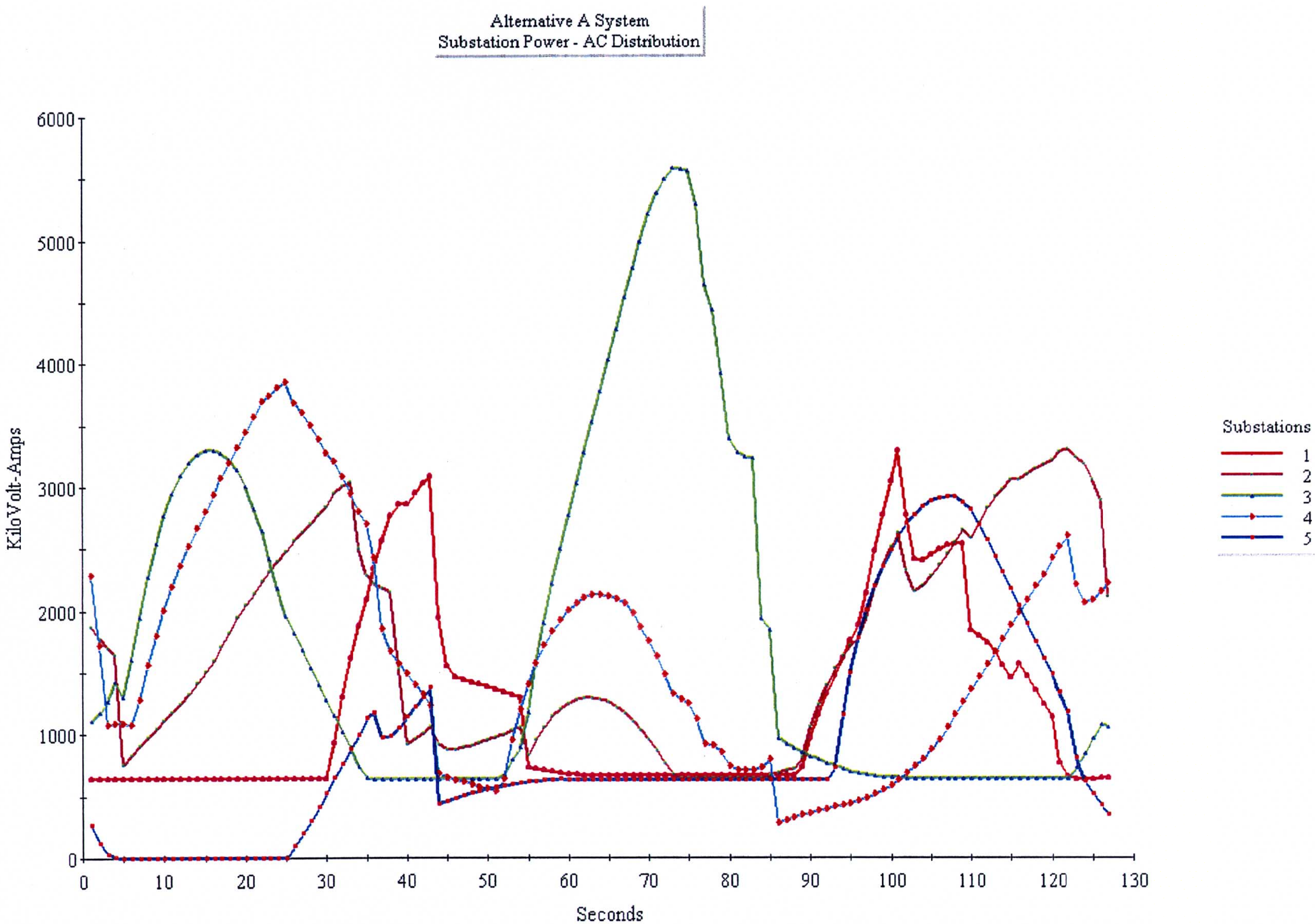
AC - 47,800,000 kw-hr/yr for train propulsion only and
59,400,000 kw-hr/yr for train propulsion plus ancillary loads

DC - 50,400,000 kw-hr/yr for train propulsion only and
62,000,000 kw-hr/yr for train propulsion plus ancillary loads

It should be noted that if the selected APM supplier utilizes an AC power distribution system, it will be necessary to power all substations from a single feeder. This will require that the two primary voltage feeders be distributed from a single point to all substations. When comparing the total cost of an AC distribution system versus a DC distribution system, the costs associated with distributing the primary voltage feeders for an AC distribution system are somewhat offset by the costs of the rectifier assemblies required for a DC distribution system.

APPENDIX A
ALTERNATIVE A POWER CONSUMPTION DIAGRAMS


Alternative A Non-Secure System
Substation Power - DC Distribution
Kilo Volt-Amps
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
Seconds
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Substations
1
2
3
4
5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4000
3000
2000
1000
0
Kilo Volt-Amps
0
10
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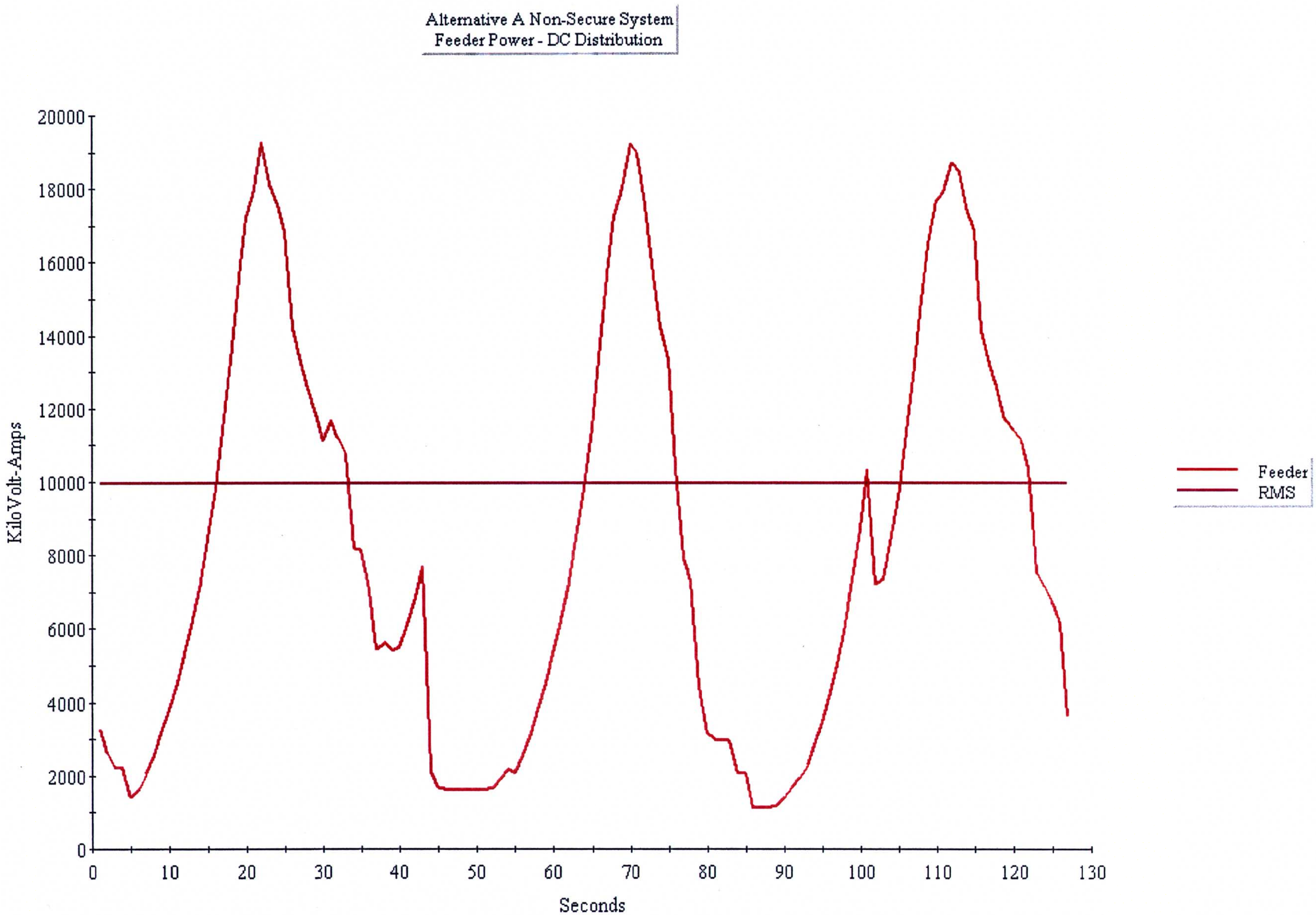
50
60
70
80
90
100
110
120
130
Seconds
Substations
1
2
3
4
5


Alternative A Non-Secure System
Feeder Power - DC Distribution
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18000
16000
14000
12000
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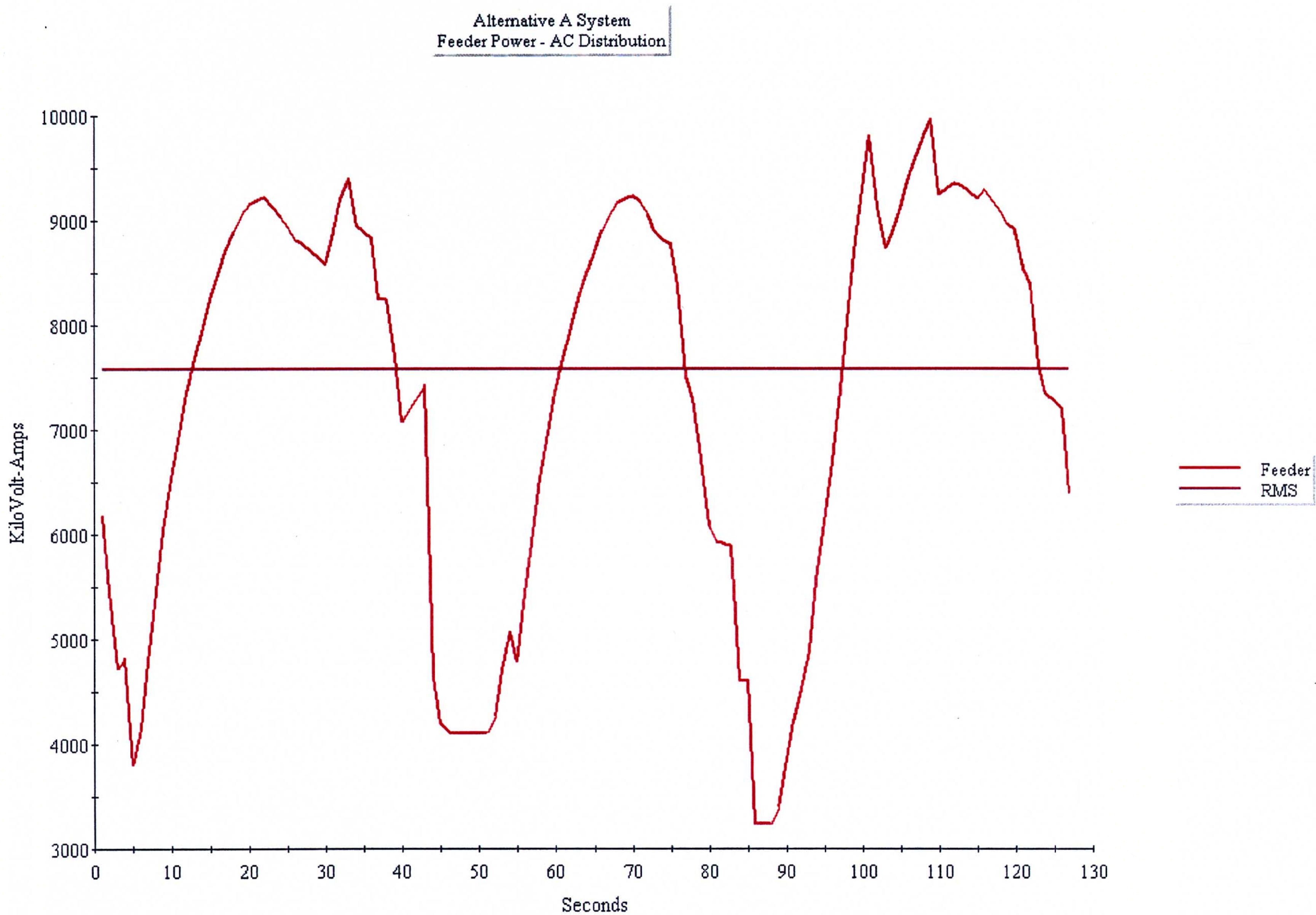
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Seconds
Feeder
RMS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KiloVolt-Amps
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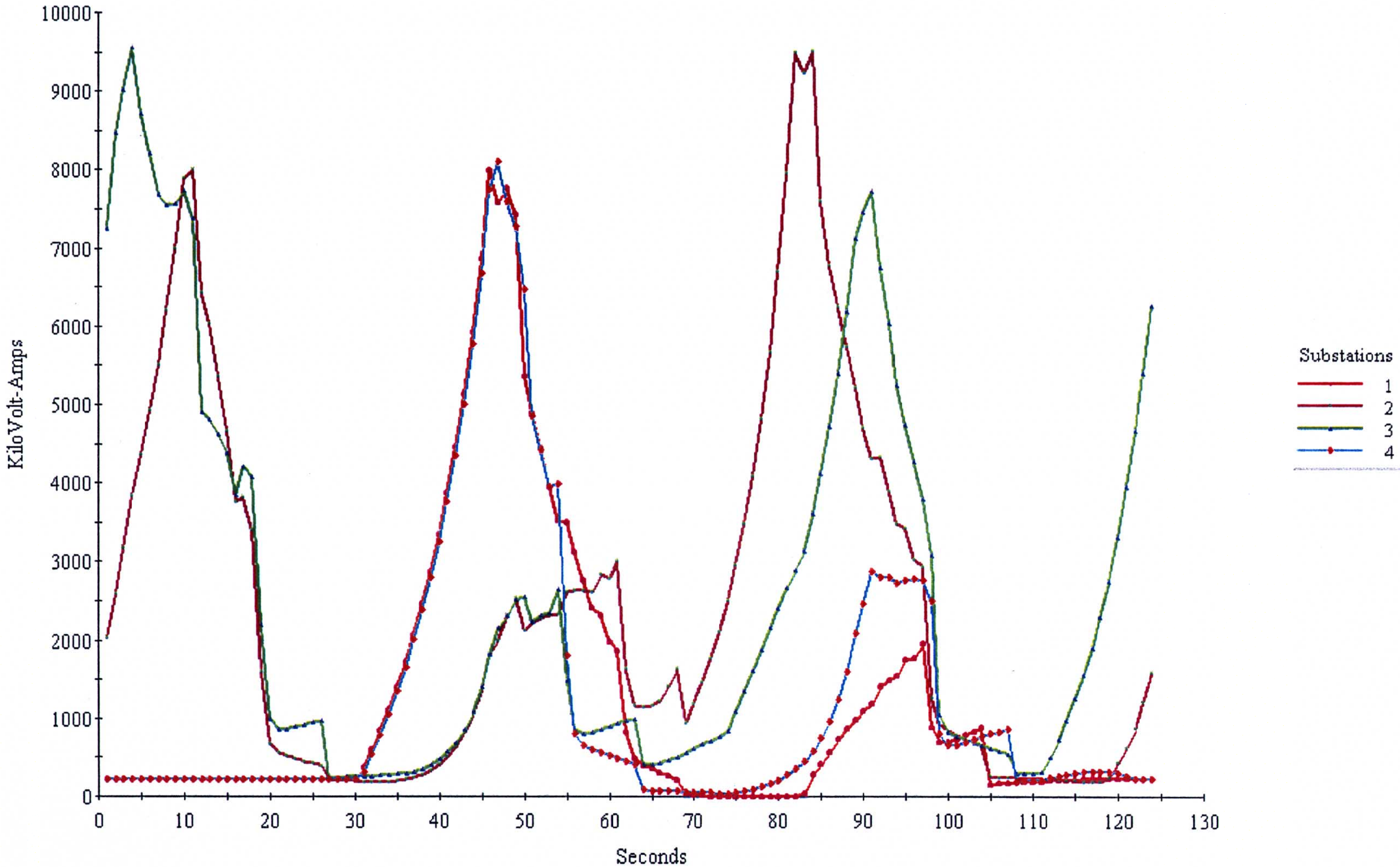
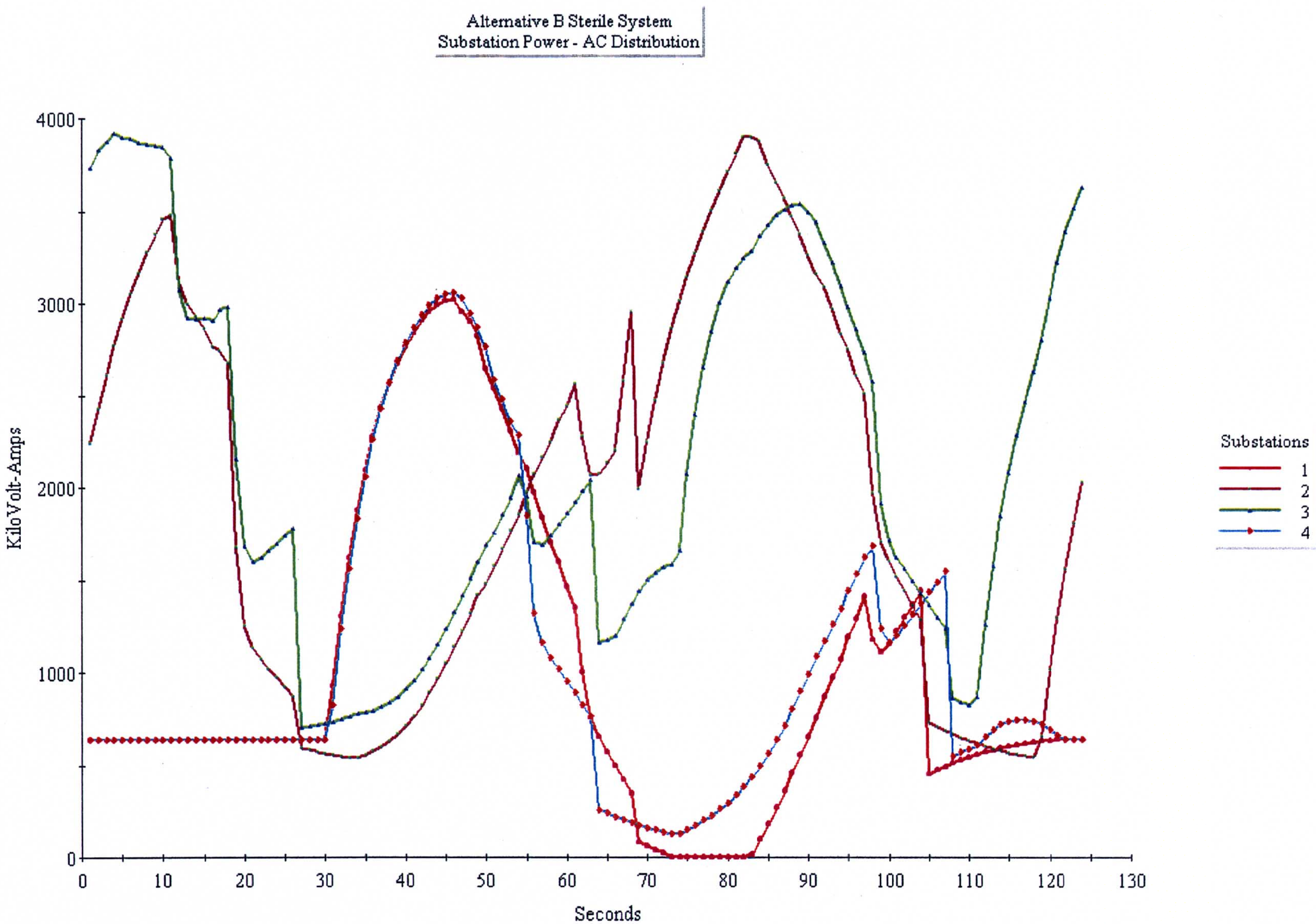
9000
8000
7000
6000
5000
4000
3000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Seconds
Feeder
RMS

Alternative B Sterile System
Substation Power - DC Distribution

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Kilo Volt-Amps
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3000
2000
1000
0
0
10
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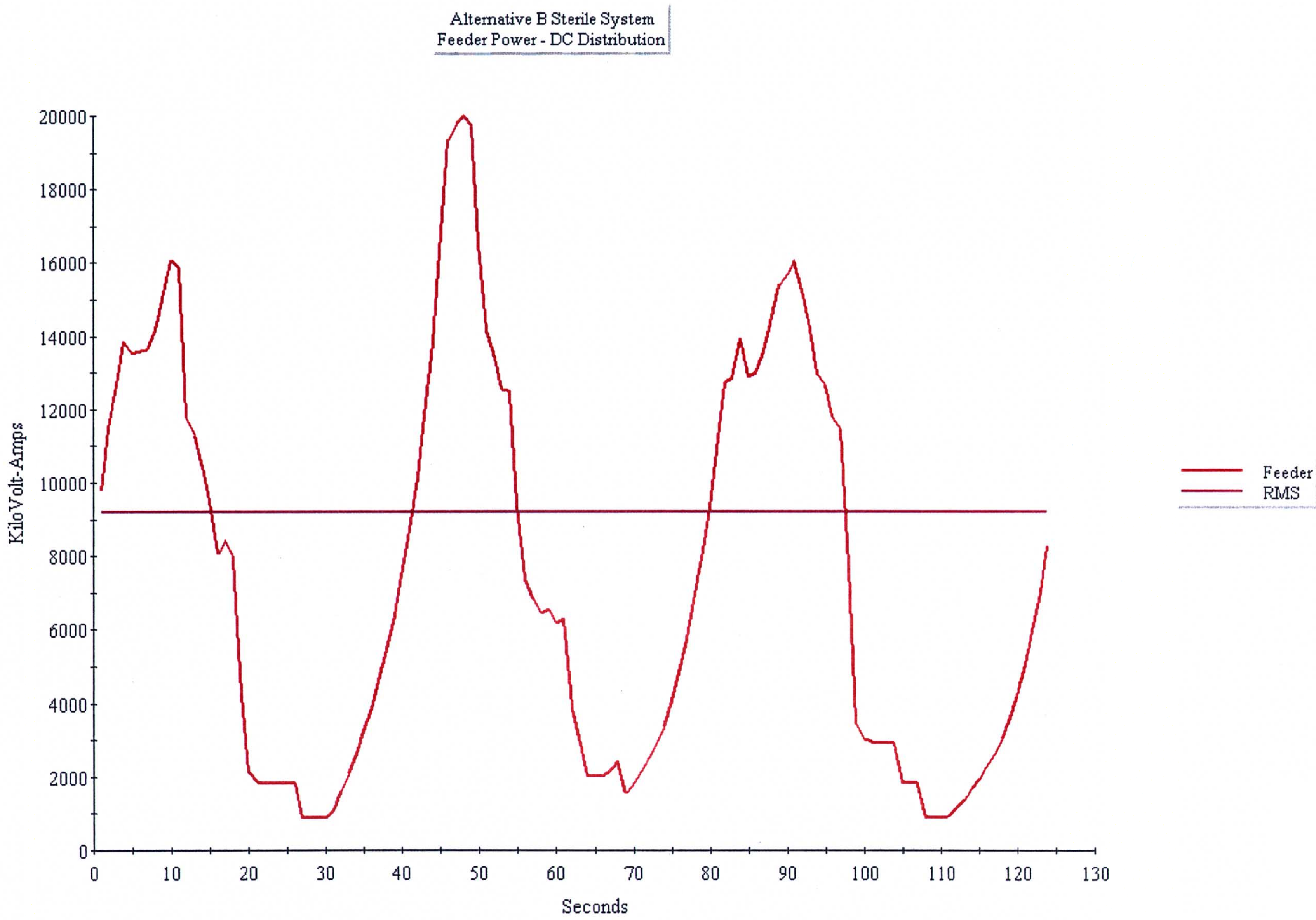
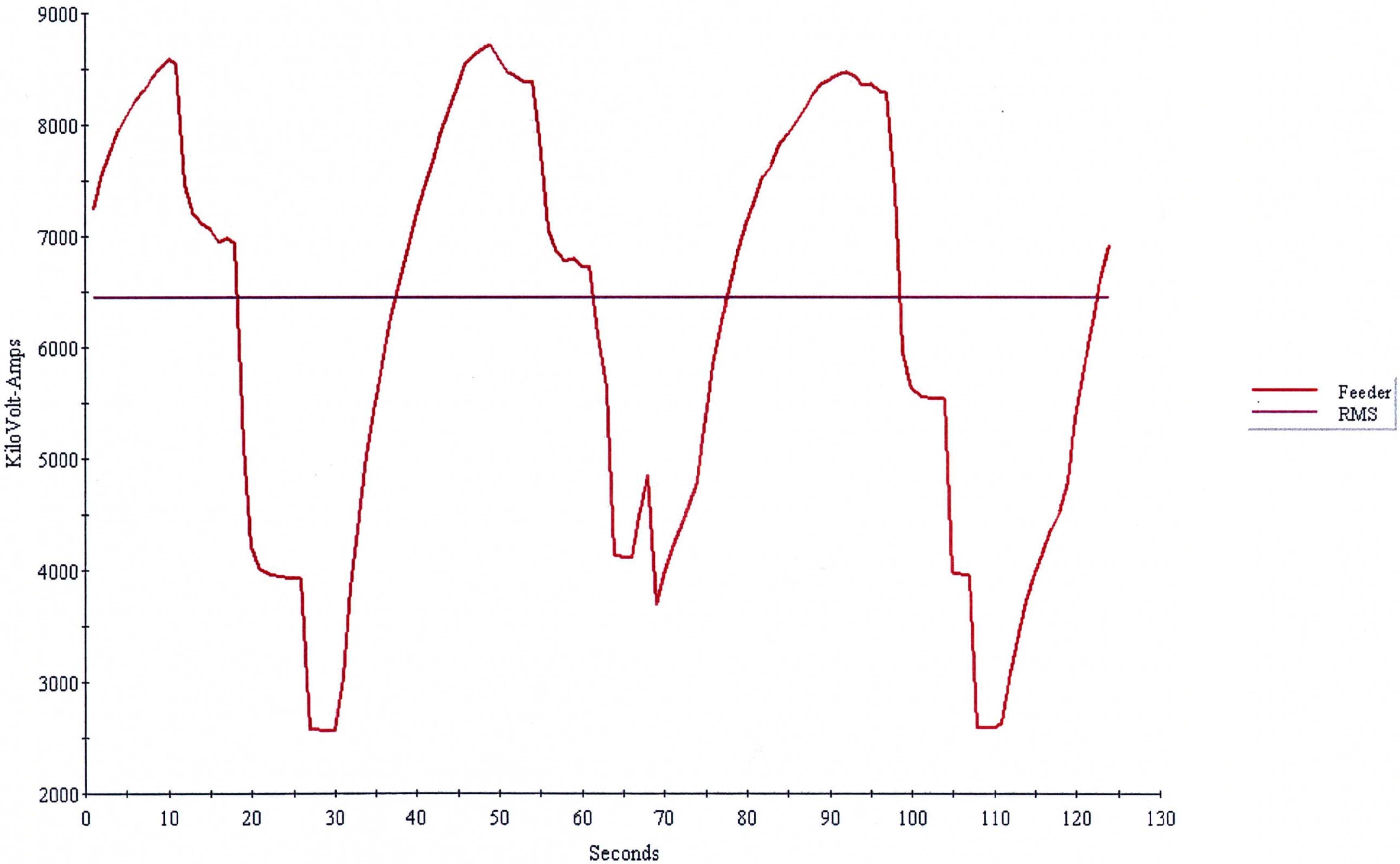
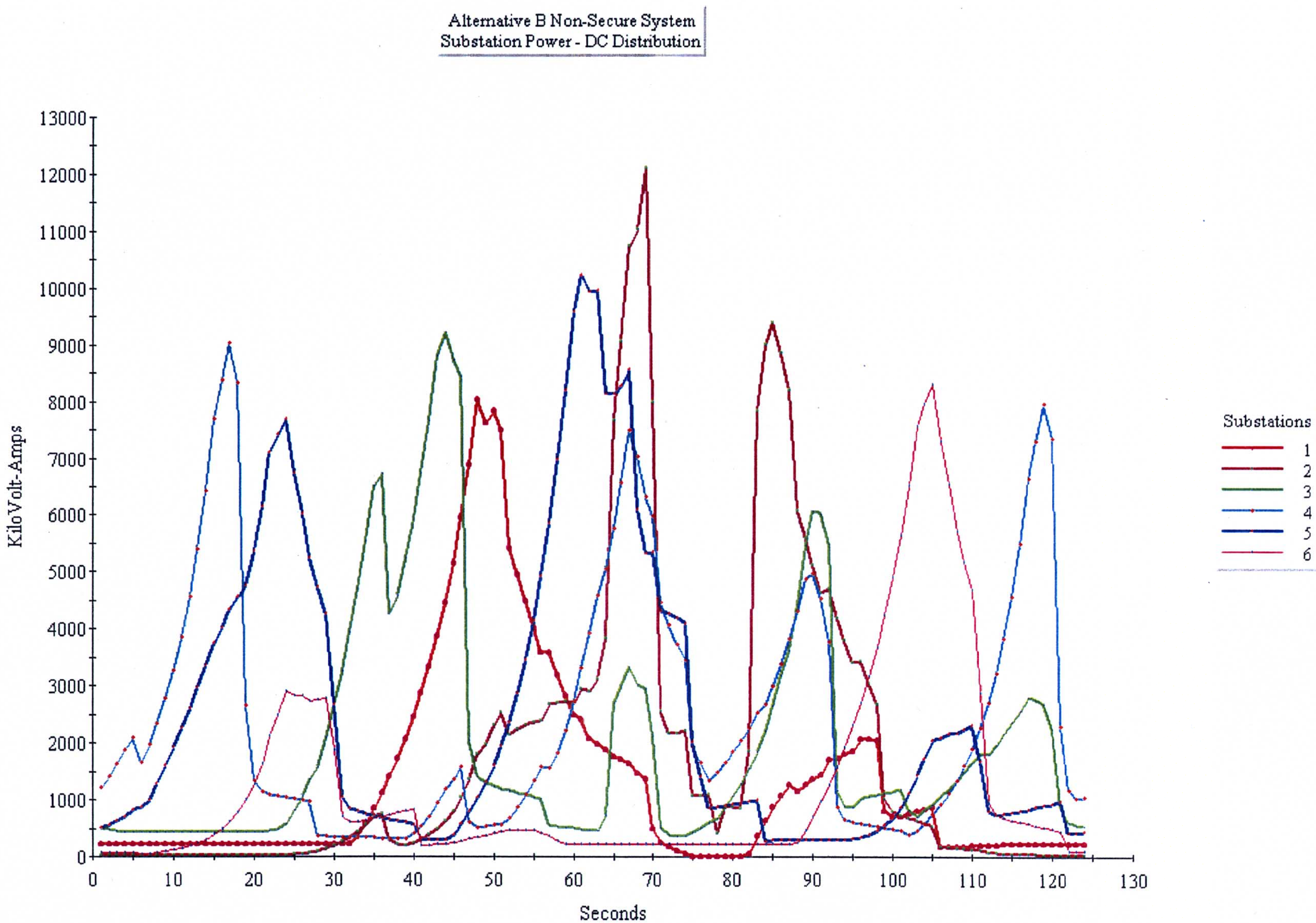
40
50
60
70
80
90
100
110
120
130
Seconds
Substations
1
2
3
4


Alternative B Sterile System
Feeder Power - DC Distribution
KiloVolt-Amps
Seconds
Feeder
RMS
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
0
10
20
30
40
50
60
70
80
90
100
110
120
130

Alternative B Sterile System
Feeder Power - AC Distribution




Alternative B Non-Secure System
Substation Power - DC Distribution
KiloVolt-Amps
Seconds
0
1000
2000
3000
4000
5000
6000
7000
8000
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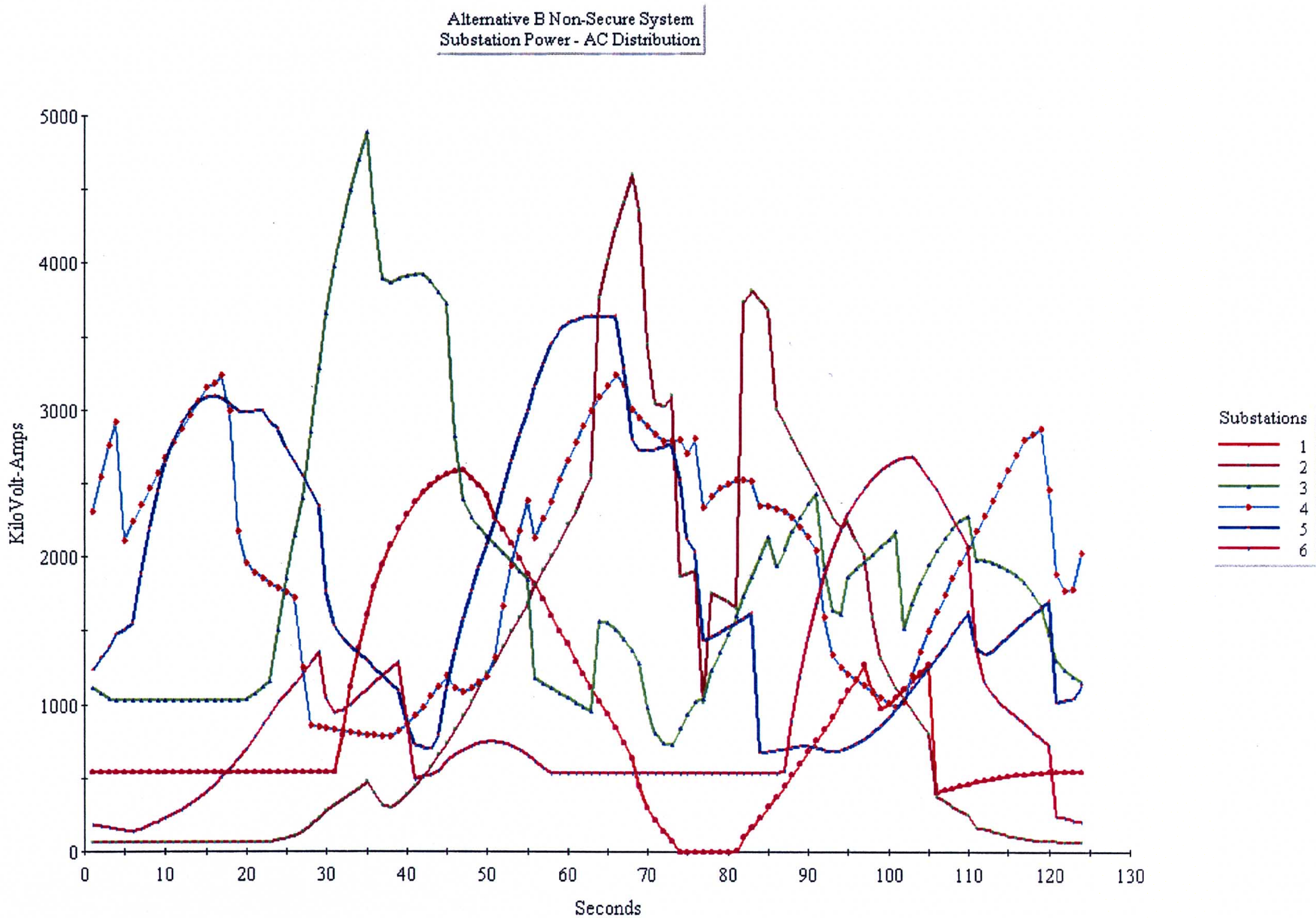
10000
11000
12000
13000
10
20
30
40
50
60
70
80
90
100
110
120
130
Substations
1
2
3
4
5
6


Alternative B Non-Secure System
Substation Power - AC Distribution
Kilo Volt-Amps
0
1000
2000
3000
4000
5000
0
10
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Seconds
Substations
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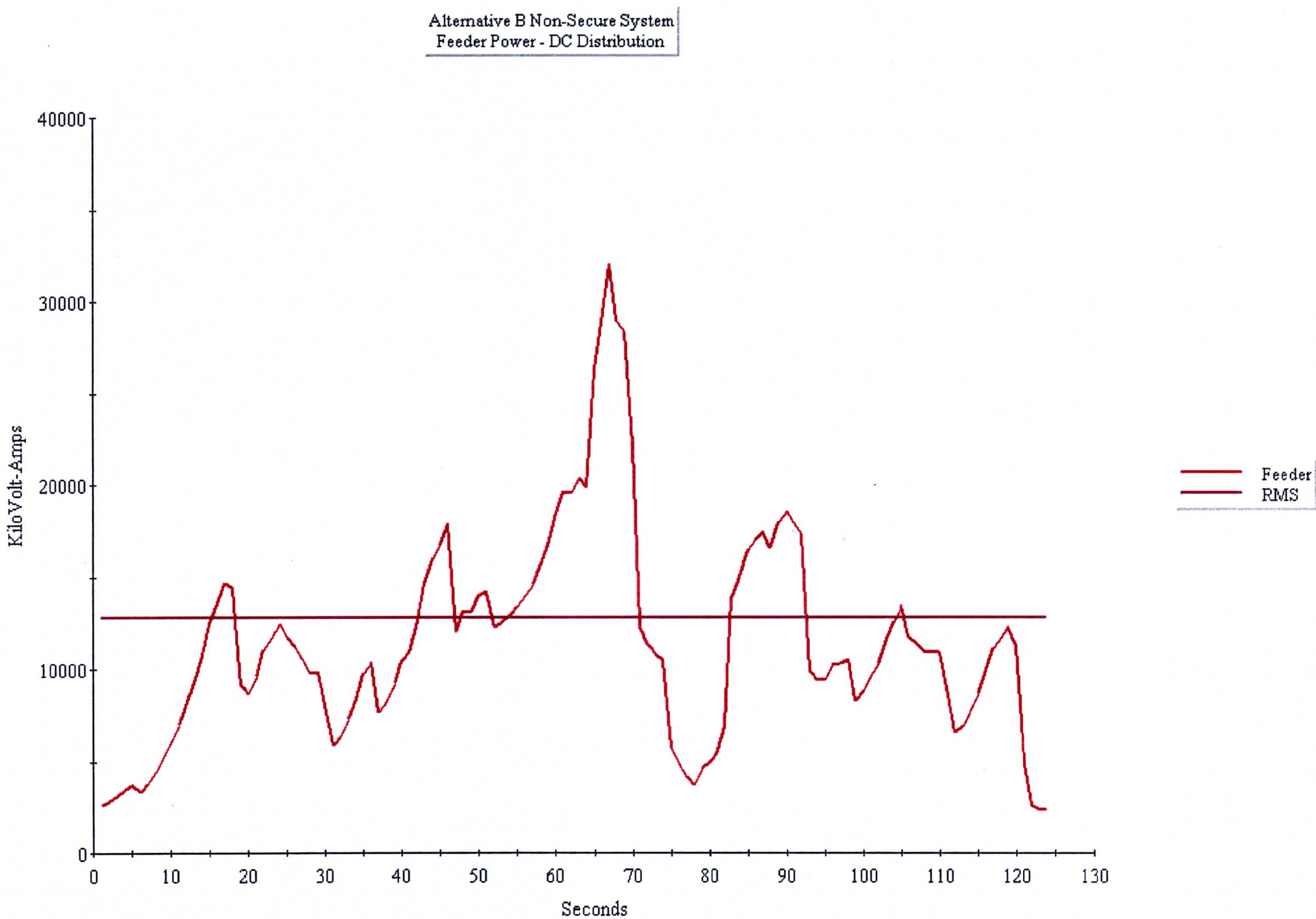
2
3
4
5
6


Alternative B Non-Secure System
Feeder Power - DC Distribution
KiloVolt-Amps
40000
30000
20000
10000
0
0
10
20
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50
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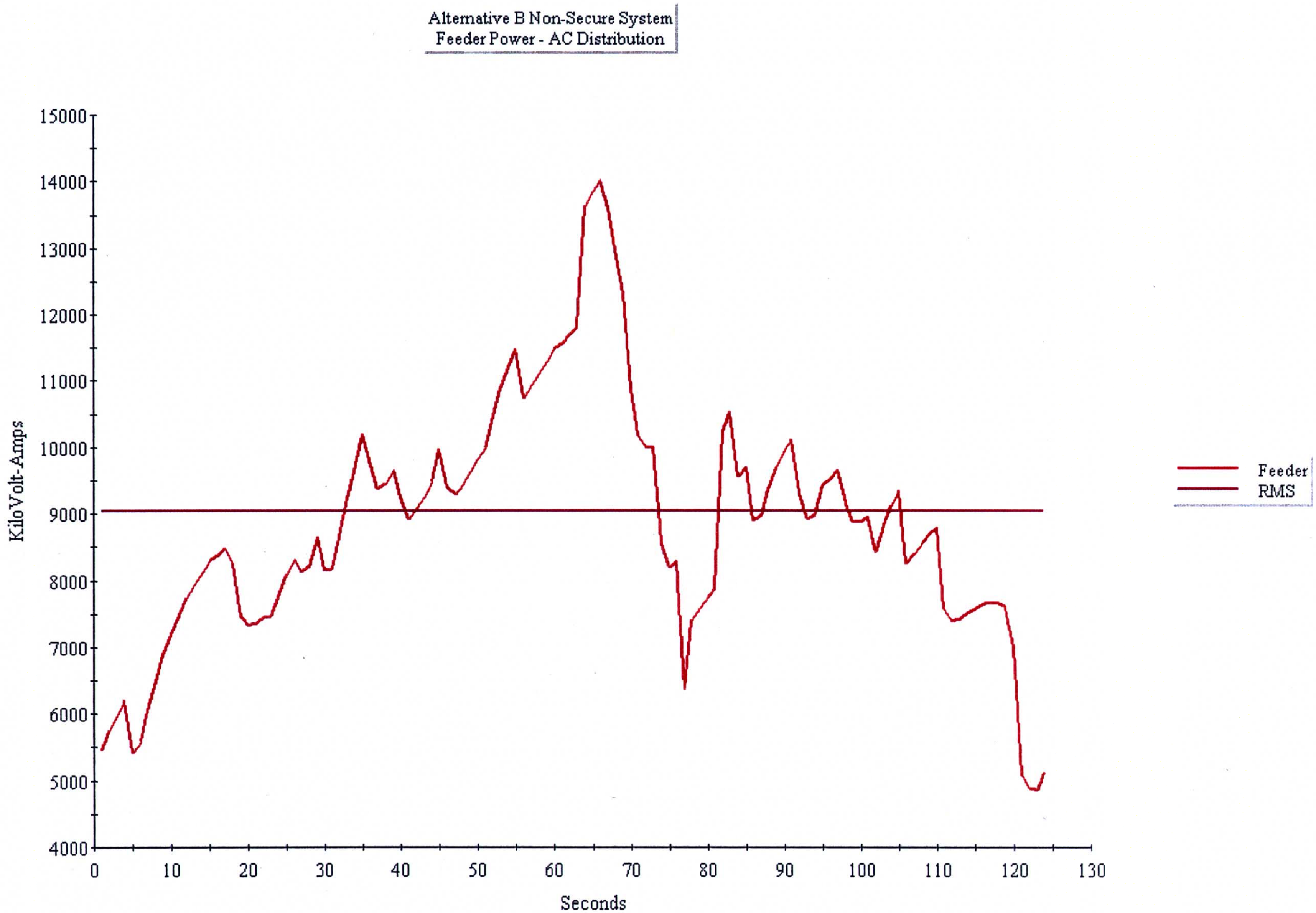
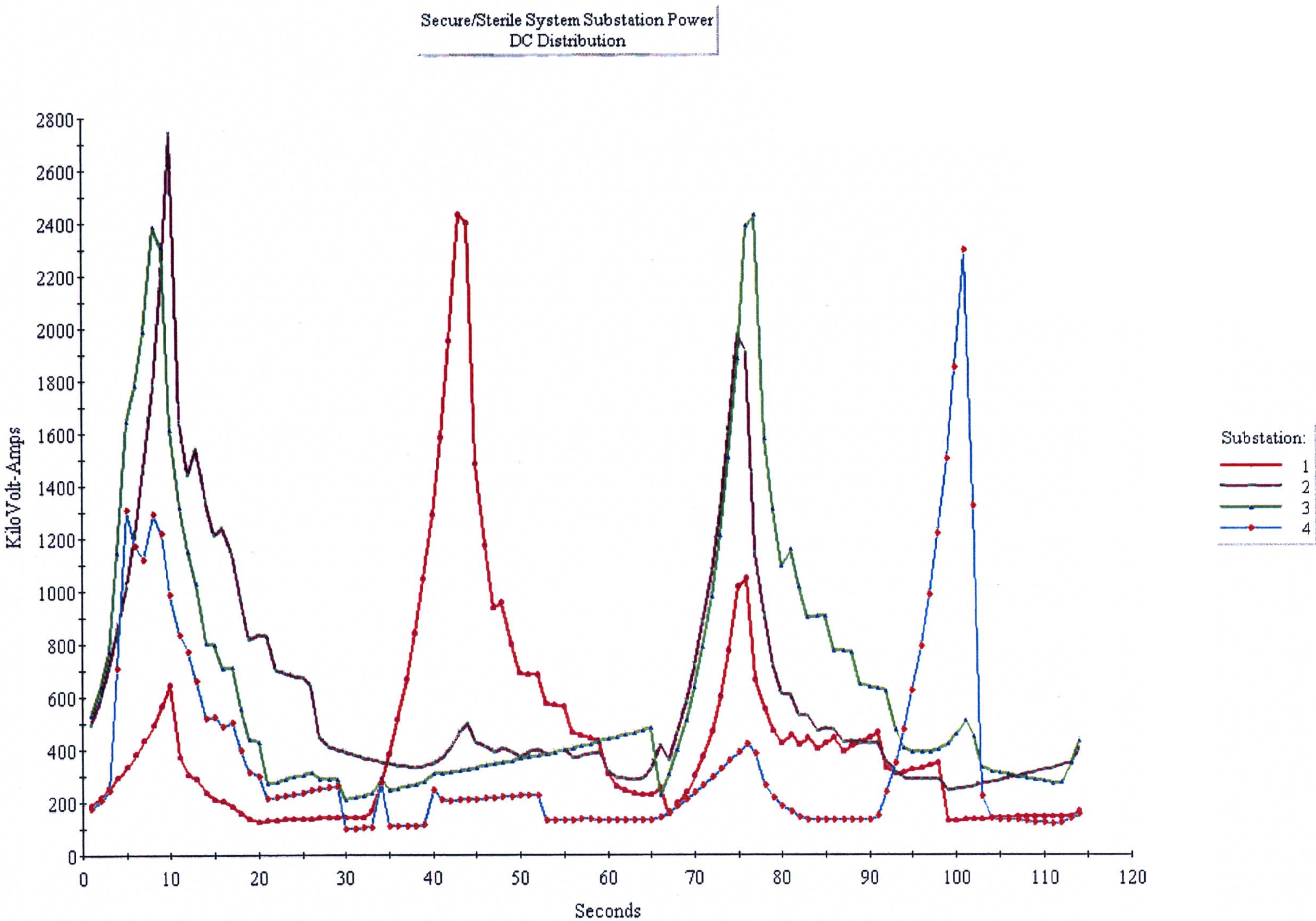
70
80
90
100
110
120
130
Seconds
Feeder
RMS


Alternative B Non-Secure System
Feeder Power - AC Distribution
Kilo Volt-Amps
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Seconds
Feeder
RMS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400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
Seconds
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50
60
70
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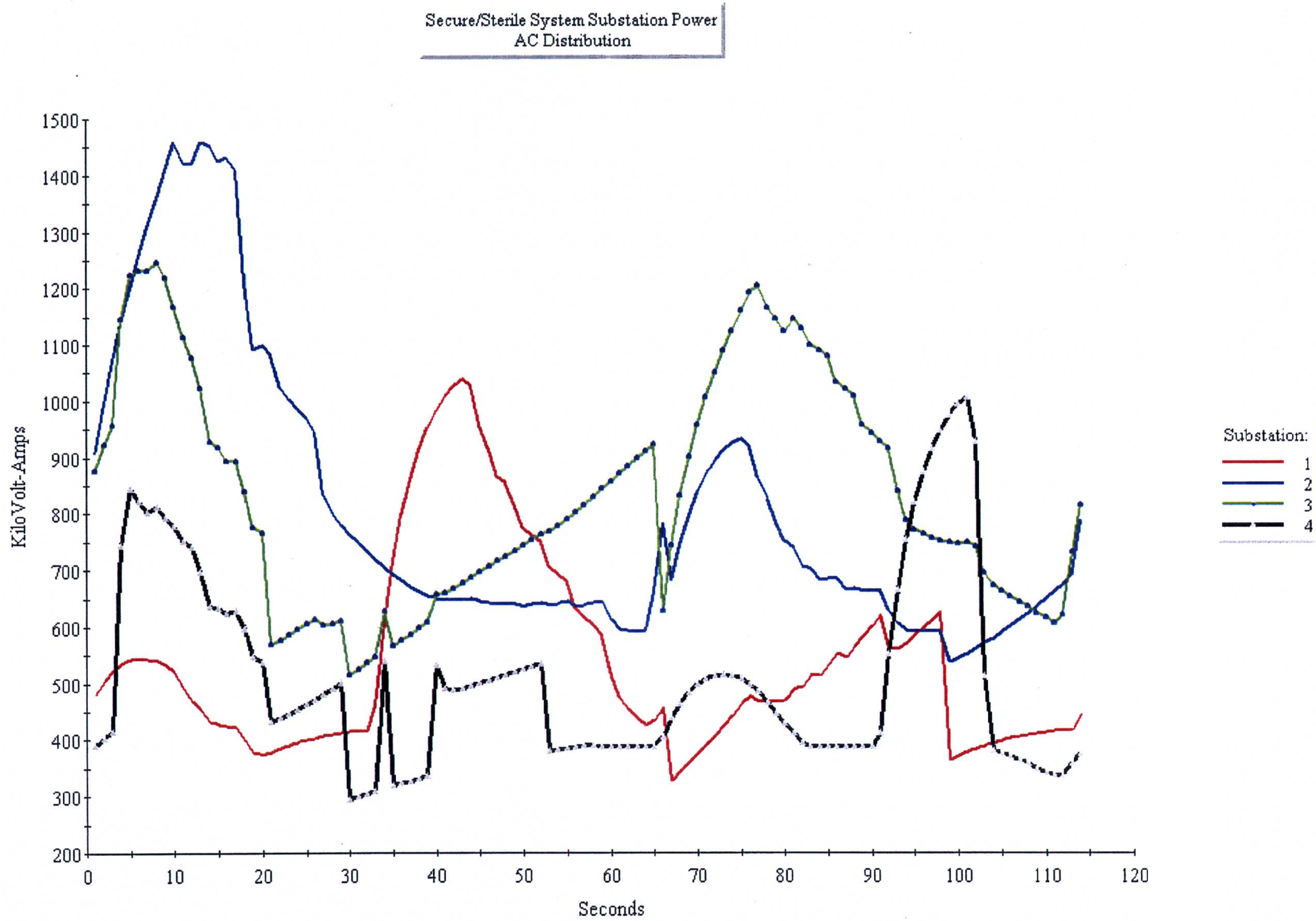
90
100
110
120
Substation:
1
2
3
4


Secure/Sterile System Substation Power
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1300
1200
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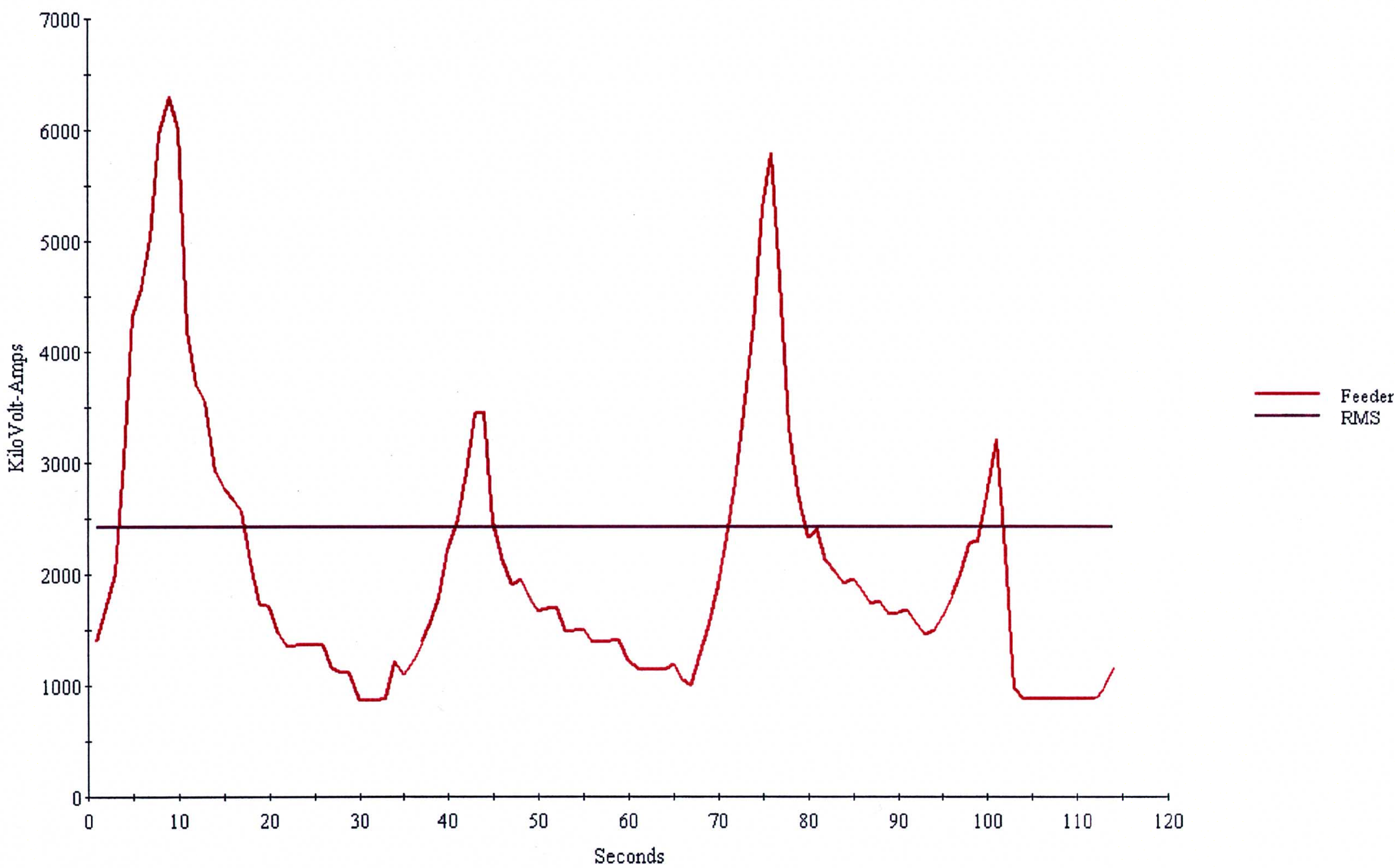
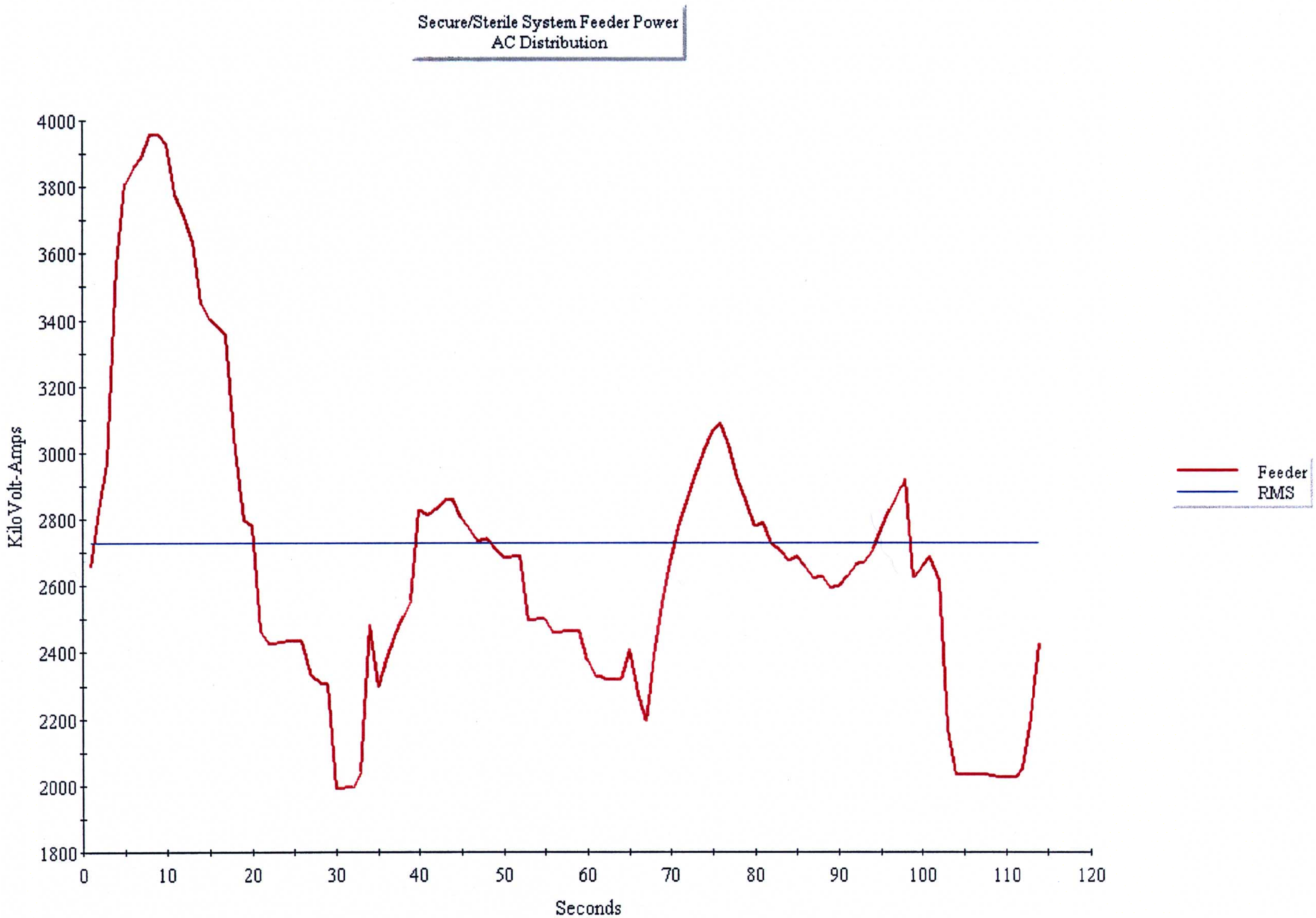
1000
900
800
700
600
500
400
300
200
Kilo Volt-Amps
0
10
20
30
40
50
60
70
80
90
100
110
120
Seconds
Substation:
1
2
3
4

Secure/Sterile System Feeder Power
DC Distribution




Secure/Sterile System Feeder Power
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Kilo Volt-Amps
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3800
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
0
10
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40
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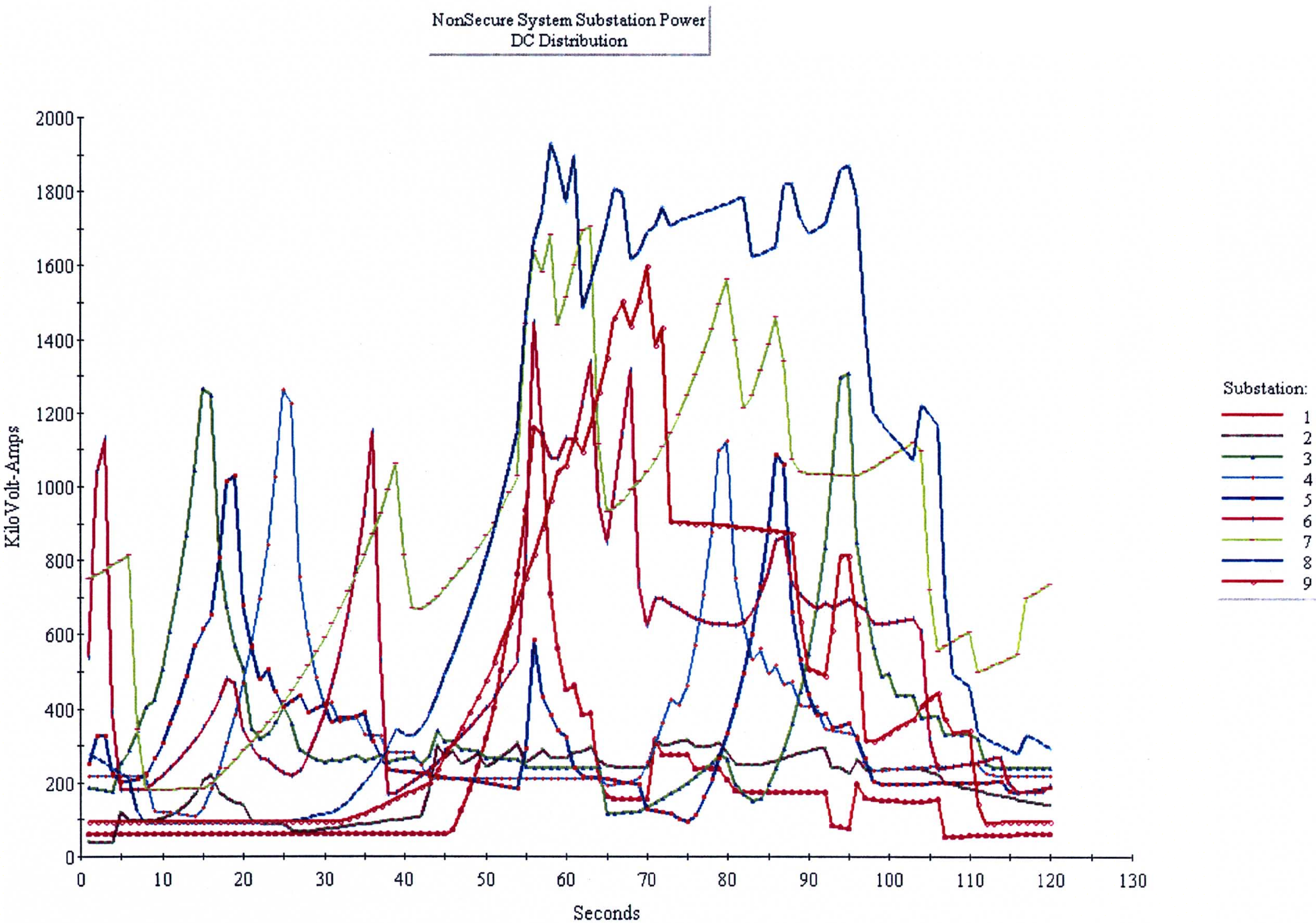
80
90
100
110
120
Seconds
Feeder
RMS


NonSecure System Substation Power
DC Distribution
Kilo Volt-Amps
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200
400
600
800
1000
1200
1400
1600
1800
2000
0
10
20
30
40
50
60
70
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100
110
120
130
Seconds
Substation:
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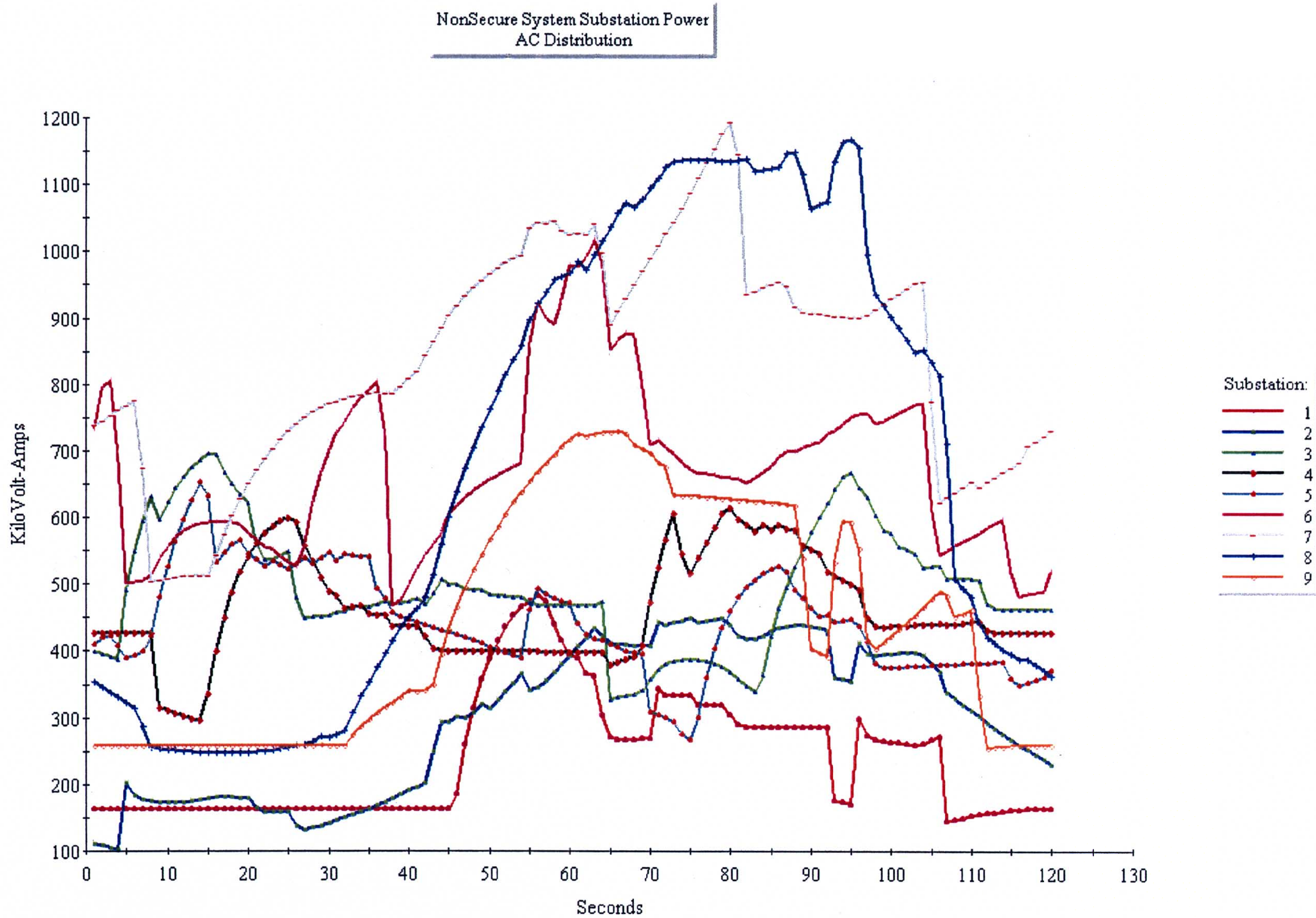
4
5
6
7
8
9


NonSecure System Substation Power
AC Distribution
Kilo Volt-Amps
Seconds
Substation:
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2
3
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1000
900
800
700
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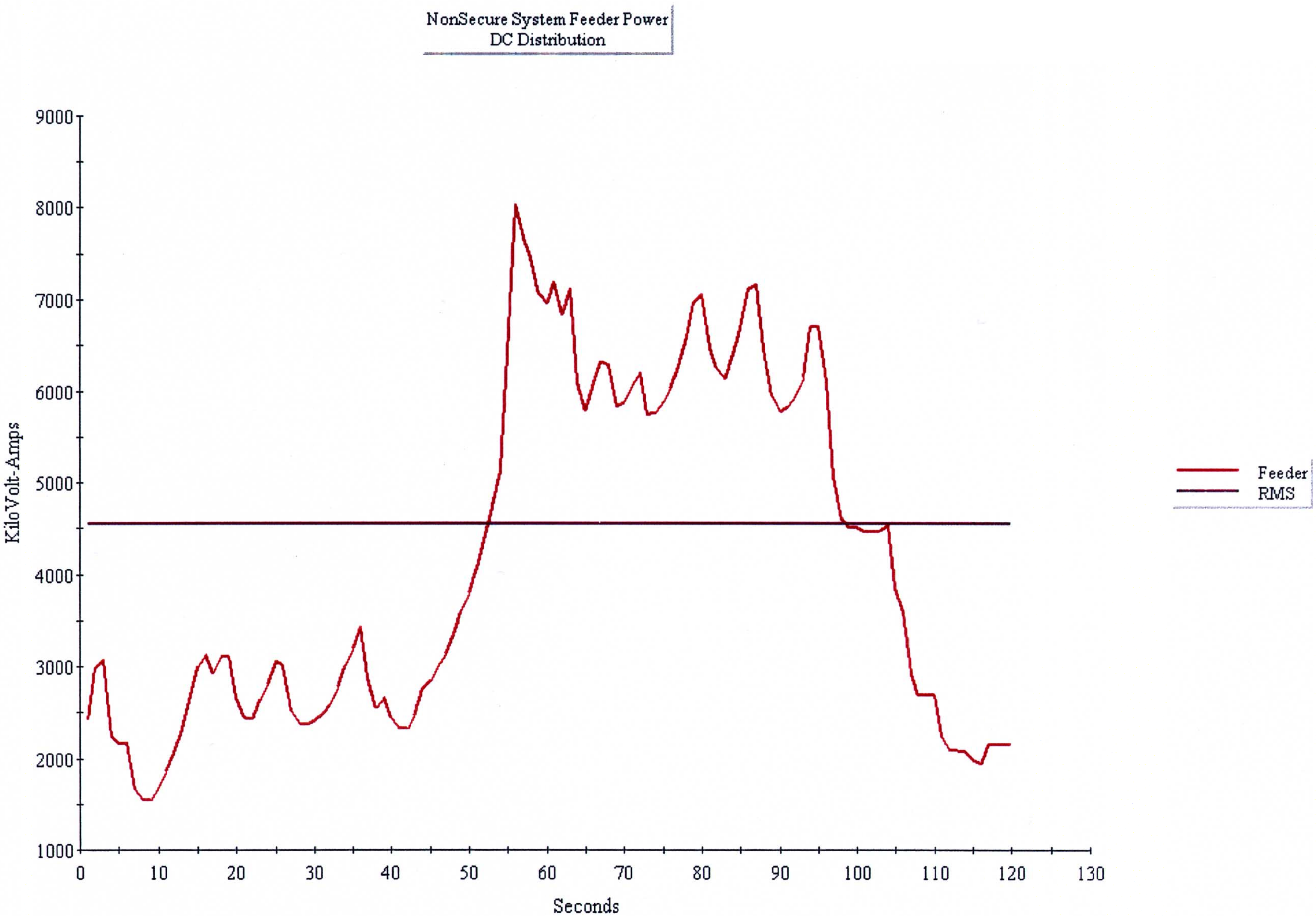
120
130


NonSecure System Feeder Power
DC Distribution
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6000
5000
4000
3000
2000
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Kilo Volt-Amps
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70
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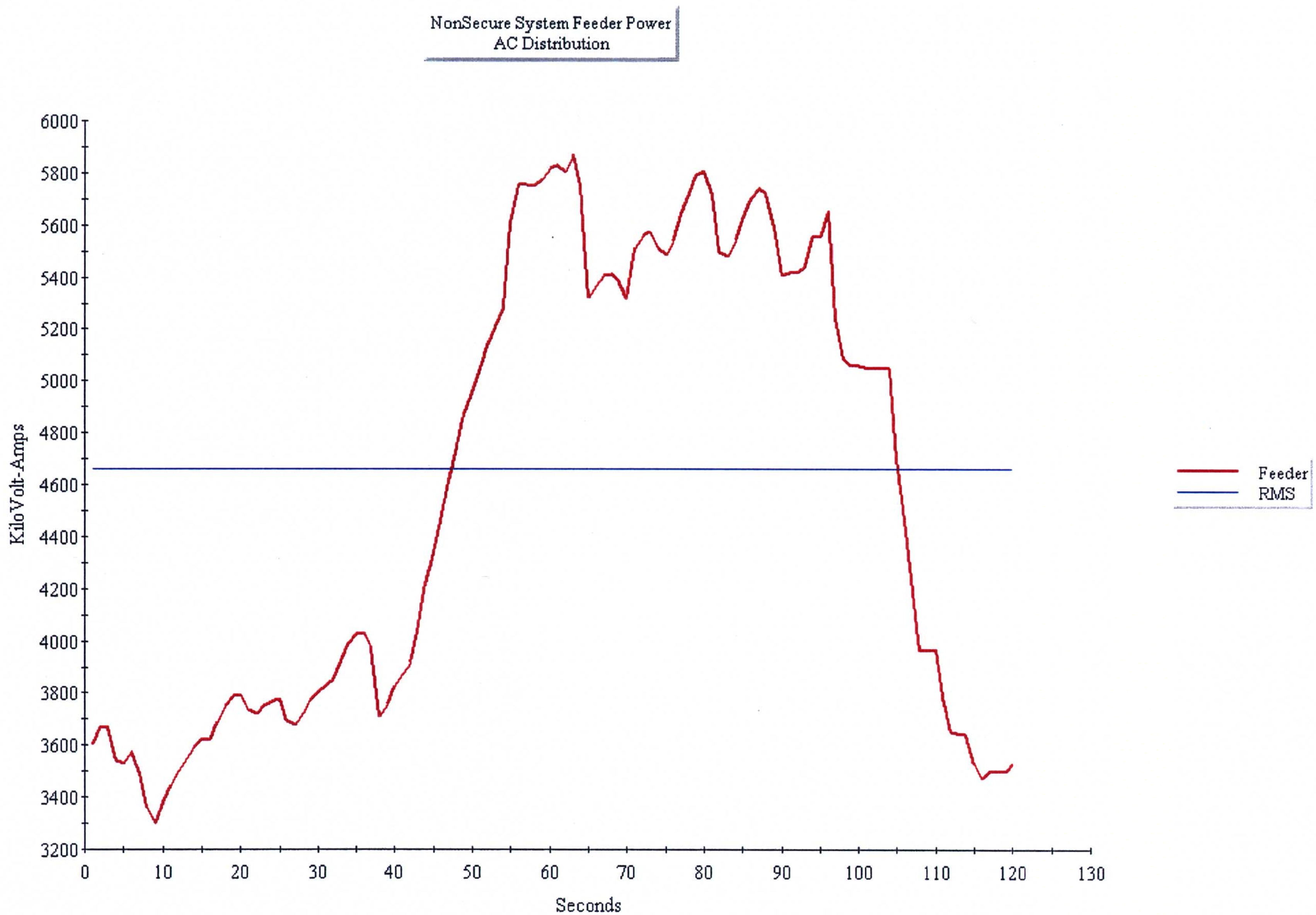
100
110
120
130
Seconds
Feeder
RMS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3600
3400
3200
KiloVolt-Amps
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30
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60
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80
90
100
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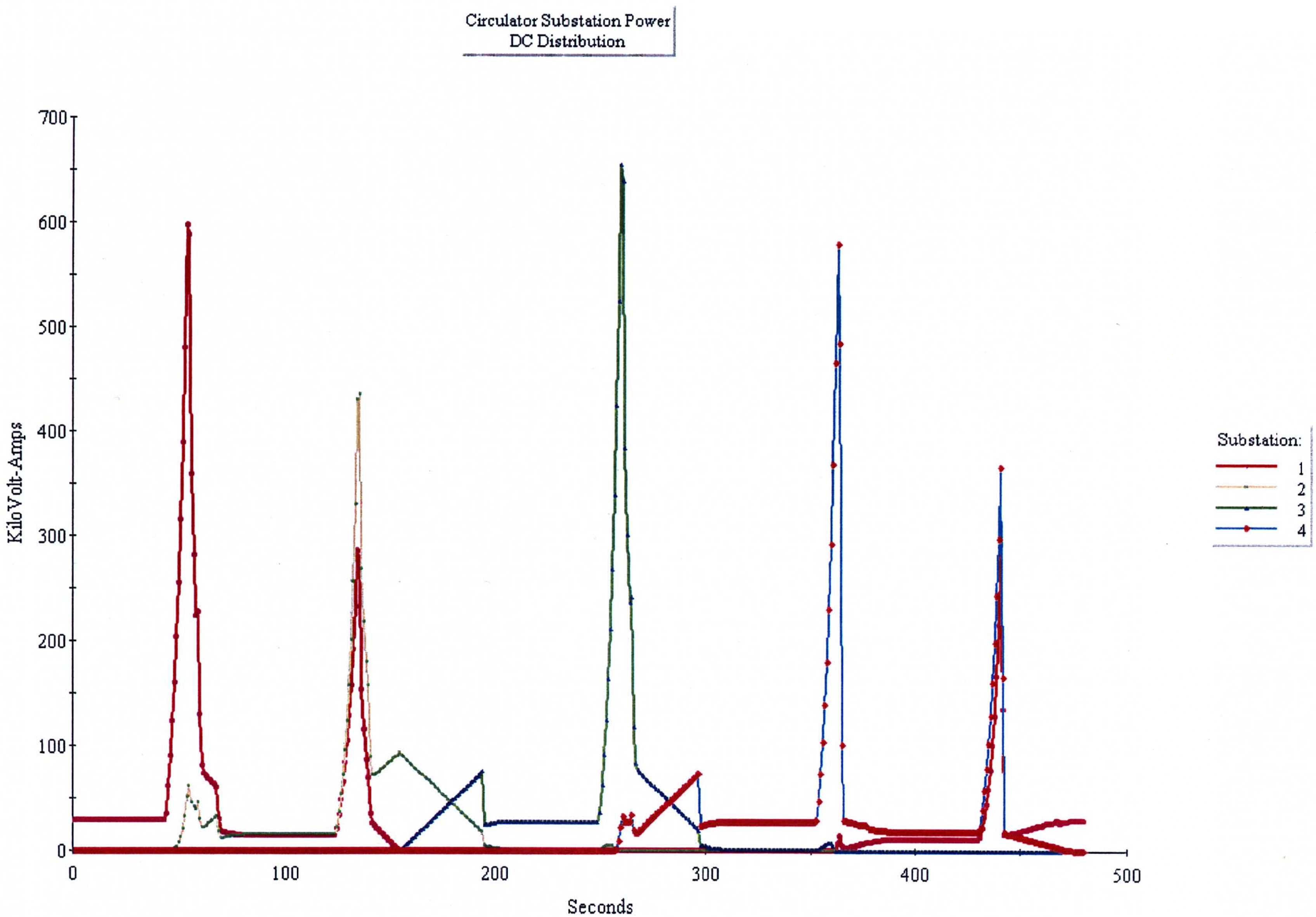
120
130
Seconds
Feeder
RMS


Circulator Substation Power
DC Distribution
Kilo Volt-Amps
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400
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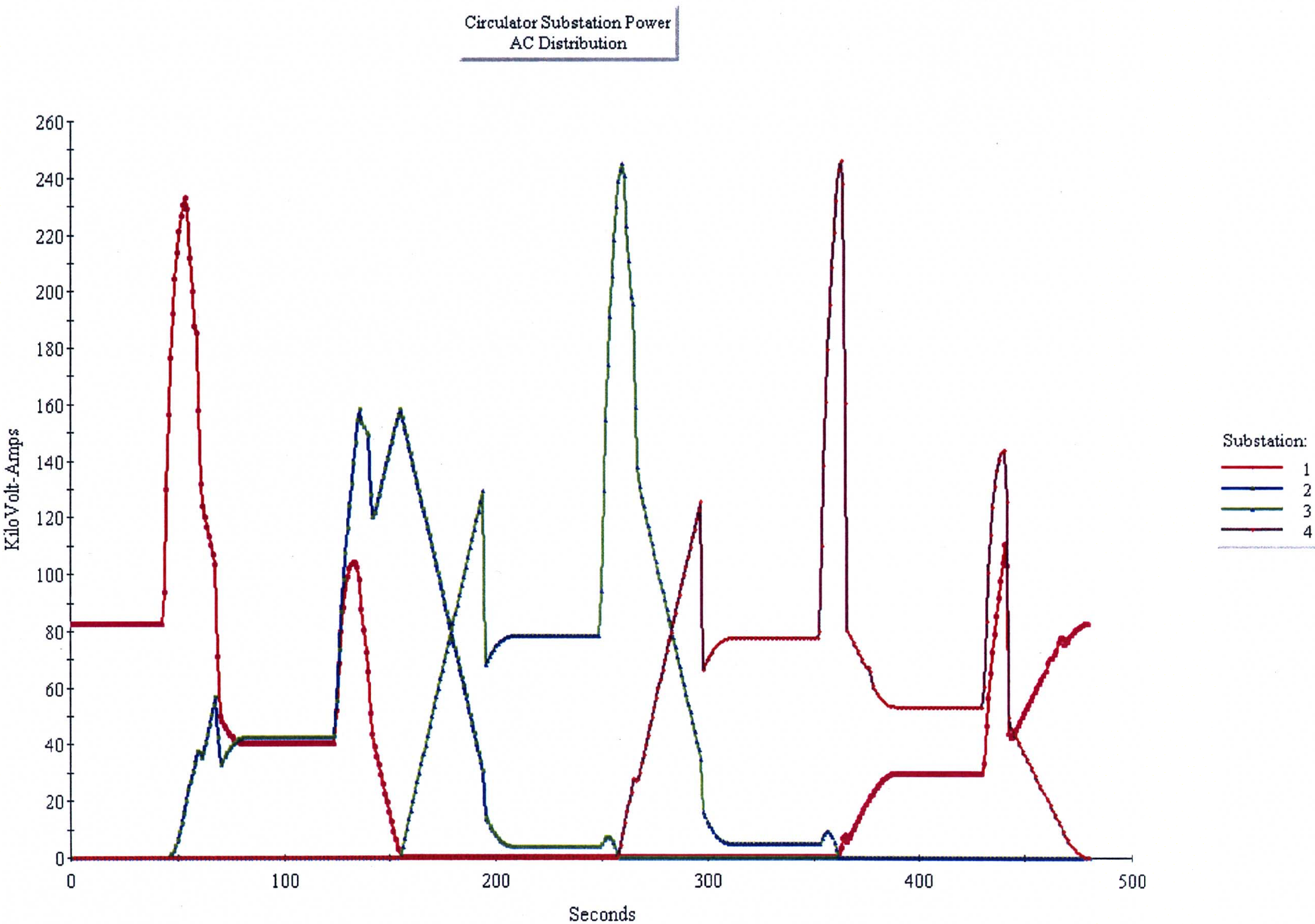
Seconds
Substation:
1
2
3
4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AC Distribution
KiloVolt-Amps
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20
40
60
80
100
120
140
160
180
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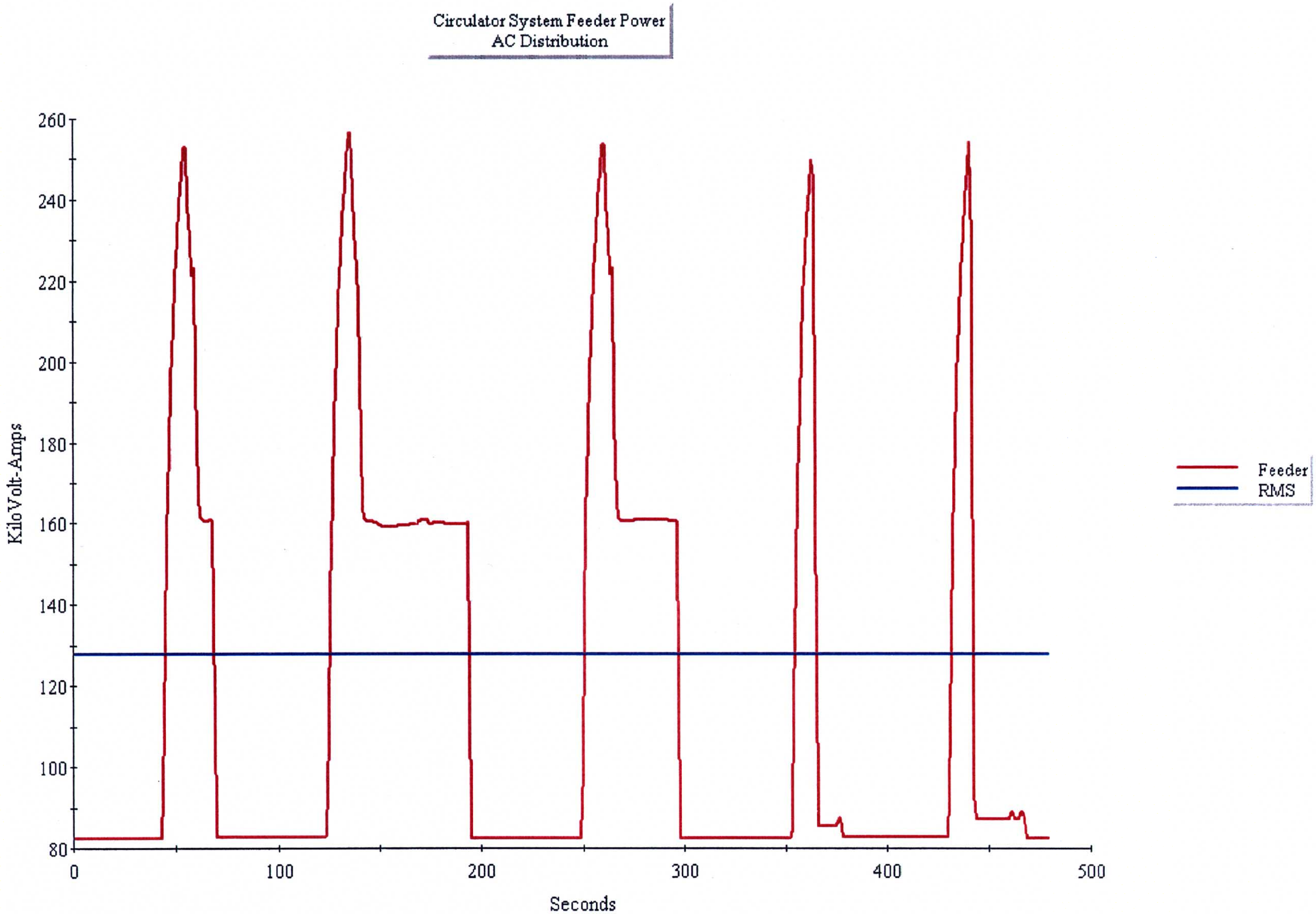
220
240
260
Seconds
0
100
200
300
400
500
Substation:
1
2
3
4


Circulator System Feeder Power
AC Distribution
Kilo Volt-Amps
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200
180
160
140
120
100
80
0
100
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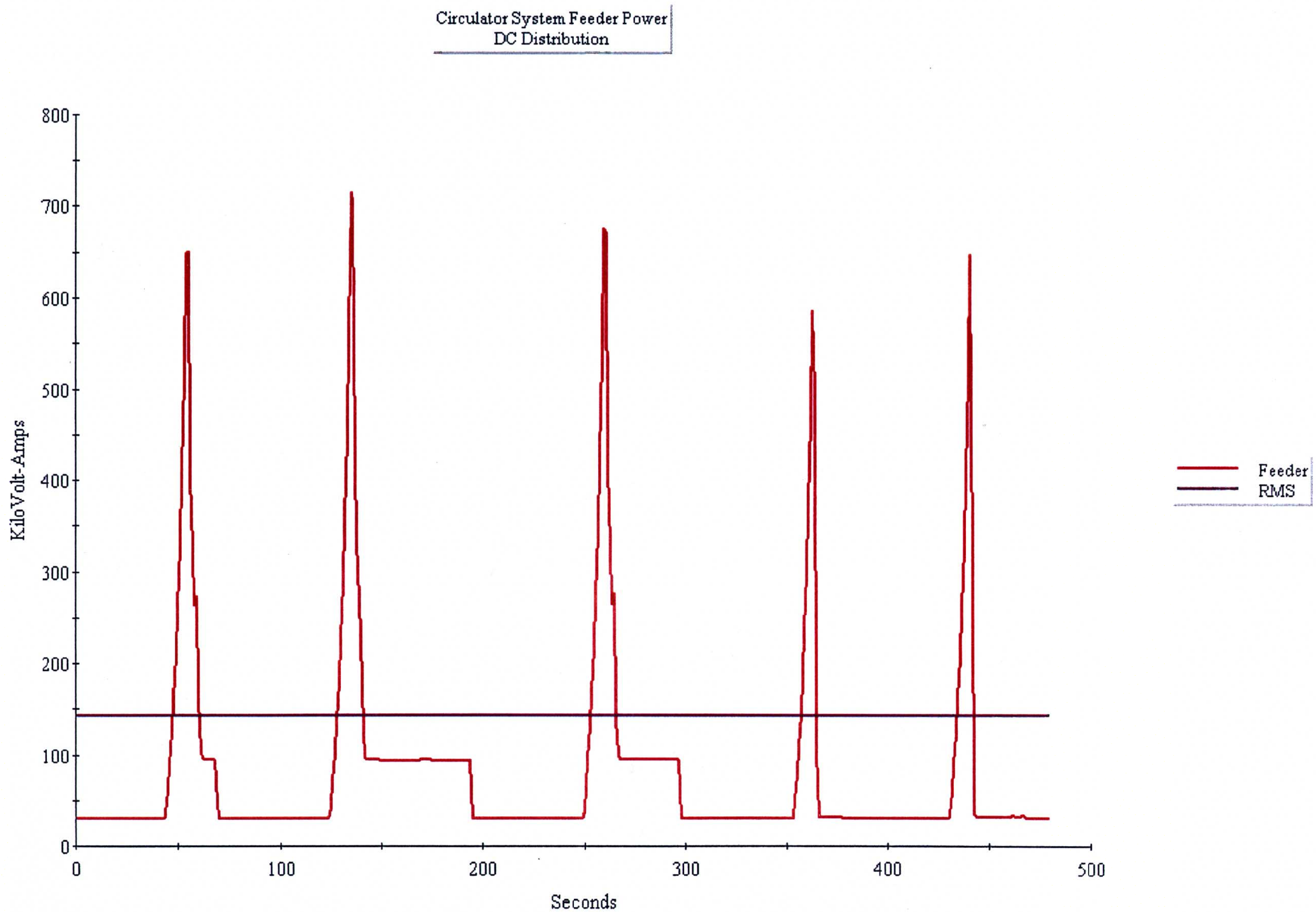
400
500
Seconds
Feeder
RMS


Circulator System Feeder Power
DC Distribution
KiloVolt-Amps
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
Seconds
Feeder
RMS