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ORIGINAL

January 29, 2009

Ernest Johnson
Director, Utilities Division
Arizona Corporation Commission
1200 West Washington St.
Phoenix, Arizona 85007

RE: ARIZONA PUBLIC SERVICE COMPANY TEN-YEAR PLAN
Docket No. E-00000D-09-0020

Dear Mr. Johnson:

In compliance with A.R.S. § 40-360.02, enclosed please find Arizona Public Service Company's ("APS") 2009-2018 Ten-Year Plan for major transmission facilities, which includes the internal planning criteria and system ratings as required by Arizona Corporation Commission ("ACC")Decision No. 63876 (July 25,2001). The Ten-Year Plan as well as other APS reliability-related infrastructure investments are premised on a number of assumptions including future growth, resource mix, the regulatory treatment of such investments by the ACC and the Federal Energy Regulatory Commission ("FERC"), other state and federal policies affecting transmission, and, of course, APS's ability to finance large investments of this nature on commercially-reasonable terms.

The 2009-2018 Ten-Year Plan describes planned transmission lines of 115 kV or higher that APS may construct over the next 10 years. This Ten-Year Plan includes approximately 181 miles of new 500 kV transmission lines, 96 miles of new 230 kV transmission lines, 6 miles of new 115kV transmission lines, and 15 new bulk transformers. The APS investment needed to construct these projects is currently estimated to exceed $990 million. When completed, these projects are expected to add approximately 2,000 MW of additional Extra-High Voltage scheduling capability, as well as 3,008 MW of import capability into the Metropolitan Phoenix Area and 232 MW of import capability into Yuma. These new transmission projects, coupled with additional distribution and sub-transmission investments, will support reliable power delivery in APS's service area, Arizona, and in the western United States.

If you or your staff have any questions regarding the enclosed information, please contact Jeff Johnson at (602) 250-2661.

Sincerely,

Leland R. Snook

Leland R. Snook

Cc: Docket Control (Original, plus 13 copies)
John Foreman, Assistant Attorney General
Brian Bozzo, Compliance & Enforcement

Enclosures

Arizona Corporation Commission
DOCKETED
JAN 29 2009
DOCKETED BY

ARIZONA PUBLIC SERVICE COMPANY
2009–2018
TEN-YEAR PLAN

Prepared for the

Arizona Corporation Commission

January 2009

ARIZONA PUBLIC SERVICE COMPANY
2009–2018
TEN-YEAR PLAN

Prepared for the

Arizona Corporation Commission

January 2009

ARIZONA PUBLIC SERVICE COMPANY
2009 - 2018
TEN-YEAR PLAN

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ARIZONA PUBLIC SERVICE COMPANY
2009–2018
TEN-YEAR PLAN

GENERAL INFORMATION

Pursuant to A.R.S. § 40-360.02, Arizona Public Service Company ("APS") submits its 2009-2018 Ten-Year Plan. Additionally, pursuant to Arizona Corporation Commission ("Commission") Decision No. 63876 (July 25, 2001) concerning the first Biennial Transmission Assessment, APS is including with this filing its Transmission Planning Process and Guidelines and maps showing system ratings on APS' transmission system. The Transmission Planning Process and Guidelines outline generally APS' internal planning for its high voltage and extra-high voltage transmission system, including a discussion of APS' planning methodology, planning assumptions, and its guidelines for system performance. The system ratings maps show continuous and emergency system ratings on APS' extra-high voltage system, and on its Metro, Northern, and Southern 230kV systems.

This 2009–2018 Ten-Year Plan describes planned transmission lines of 115kV or higher voltage that APS may construct, or participate in, over the next ten-year period. Pursuant to A.R.S. § 40-360(10), underground facilities are not included. There are approximately 181 miles of 500kV transmission lines, 96 miles of 230kV transmission lines, 6 miles of 115kV transmission lines, and 15 bulk transformers contained in the projects in this Ten-Year Plan filing. The total investment for the APS projects and the anticipated APS portion of the participation projects as they are modeled in this filing is estimated to be approximately $990 Million and the projects will add an expected 2000 MW of additional EHV scheduling capability. Also, over the next ten years the import capability into the Phoenix area will increase by 3008

MW, while the import capability into the Yuma area will increase by 232 MW. The following table shows a breakdown of the projects contained in this Ten-Year Plan.

	Projects in Ten-Year Plan
500kV transmission lines	181 miles
230kV transmission lines	96 miles
115kV transmission lines	6 miles
Bulk Transformers	15
Total Investment	$ 990 Million
EHV Scheduling Capability	+2000 MW (+28 %)[1]
Total Phoenix Area Import	+3008 MW (+22 %)[1]
Yuma Area Import	+232 MW (+39 %)[1]

[1] Based on 2008 values.

Also, some of the previously reported facilities that have been completed, canceled, or deferred beyond the upcoming ten-year period are not included. The projects at the end of this Ten-Year Plan that have in-service dates of To Be Determined (TBD) are projects that have been identified, but are either still outside of the ten-year planning window or their in-service dates have not yet been established. They have been included in this filing for informational purposes. A summary of changes from last year's plan is provided below, along with a list of projects that have been added to this year's Ten-Year Plan. Also, a section is included that briefly describes any projects that are still in the feasibility planning phase.

For the convenience of the reader, APS has included system maps showing the electrical connections and in-service dates for all overhead transmission projects planned by APS for Arizona, the Phoenix Metropolitan Area, and the Yuma Area. Written descriptions of each proposed transmission project are provided on subsequent pages in the currently expected chronological order of each project. The line routings shown on the system maps and the descriptions of each transmission line are intended to be general, showing electrical connections and not specific routings, and are subject to revision. Specific routing is recommended by the

Arizona Power Plant and Transmission Line Siting Committee and ultimately approved by the Commission when issuing a Certificate of Environmental Compatibility and through subsequent right-of-way acquisition. Pursuant to A.R.S. § 40-360.02, this filing also includes technical study results for the projects identified. The technical study results show project needs which are generally based on either security (contingency performance), adequacy (generator interconnection or increasing transfer capability) or both.

APS participates in numerous regional planning organizations and in the WestConnect organization. Through membership and participation in these organizations the needs of multiple entities, and the region as a whole, can be identified and studied. This allows for the potential of maximizing the effectiveness and utilization of new projects. Regional organizations that APS is a member of include the Western Electricity Coordinating Council (WECC), the Southwest Area Transmission Planning (SWAT), and WestConnect which established a formal sub-regional transmission planning process during 2007. The plans included in this filing are the result of these coordinated planning efforts. APS is open to other entities participating in any existing or future planned projects. As a participant in the SWAT-Southeastern Arizona Transmission Study (SATS) subcommittee APS is working with other stakeholders in Cochise County to develop a transmission plan that will address the recommendations in the 2008 Biennial Transmission Assessment (BTA) regarding providing continuity of service.

As part of its planning process, APS also is evaluating the potential for renewable development and associated transmission. In response to the Fourth Biennial Transmission Assessment Decision (Decision No. 69389), on August 6, 2008, the Joint Biennial Transmission Assessment Report on Renewables and Available Transmission Capability was submitted to the Commission on behalf of APS, Salt River Project, Tucson Electric Power, and Southwest Transmission Cooperative. That report described the collaborative efforts and analysis that was

completed with Southwest Area Transmission Sub-Regional Planning Group to address transmission for renewable resources including an assessment of Available Transfer Capacity, a description of locations, and the amount of transmission needed to bring renewable resources to load. In addition, in response to the Fifth Biennial Transmission Assessment Decision (Decision No. 70635), in collaboration with other utilities, APS will develop plans to identify future renewable transmission projects and develop plans and propose funding mechanisms to construct the top three renewable transmission projects. APS has begun its process to analyze these renewable transmission projects in collaboration with other utilities. Because the study is still in progress, its findings are not included in this 10-Year Plan. However, the results will be filled with the Commission no later than October 31, 2009, and included in the Sixth Biennial Transmission Assessment, as required by Decision No. 70635.

APS believes that the projects identified in this 2009-2018 Ten-Year Plan, with their associated in-service dates, will ensure that APS' transmission system meets all applicable reliability criteria. Changes in regulatory requirements or underlying assumptions such as load forecasts, generation or transmission expansions, economic issues, and other utilities' plans, may substantially impact this Ten-Year Plan and could result in changes to anticipated in-service dates or project scopes. Additionally, future federal and regional mandates may impact this Ten-Year Plan specifically and the transmission planning process in general. This Ten-Year Plan is tentative information only and, pursuant to A.R.S. § 40-360.02(F), is subject to change without notice at the discretion of APS, based on land usage, growth pattern changes, regulatory or legal developments, or for other reasons.

Changes from 2008-2017 Ten-Year Plans

The following is a list of projects that were changed or removed from the Ten-Year plan filed last year, along with a brief description of why the change was made.

- Dugas loop-in of Navajo-Westwing 500 kV line

  The 2008-2017 Ten-Year plan has the VV01 loop-in of the 500 kV Navajo-Westwing line. In the 2009-2018 Ten-Year plan, the VV01 substation has been renamed and referred to as the Dugas substation.

- Sun Valley-Trilby Wash 230 kV line and Palm Valley-TS2-Trilby Wash 230 kV line

  In the 2009-2018 Ten-Year plan, the TS1 substation has been renamed and referred to as the Trilby Wash substation.

- TS12 loop-in of Saguaro-Casa Grande 230 kV line

  The 2008-2017 Ten-Year plan has the SE10 loop-in of the 230 kV Saguaro-Casa Grande line. In the 2009-2018 Ten-Year plan, the SE10 substation has been renamed and referred to as the TS12 substation.

- Desert Basin-Pinal Central 230 kV line and Sundance-Pinal Central 230 kV line

  In the 2009-2018 Ten-Year plan, the Pinal South substation has been renamed and referred to as the Pinal Central substation.

- Palo Verde Hub-Sun Valley 500kV line

  In the 2009-2018 Ten-Year plan, the Harquahala Junction switchyard has been renamed and referred to as the Delany switchyard.

- In-service Date Changes

  The latest load forecasts and planning studies show that the in-service dates for a number of projects can be delayed. Due to the state-wide slow-down in the economy and the housing market, the load growth in the APS service territory will be

significantly lower in the next few years than was forecasted in the prior years. The slower growth in electrical demand means the need dates for a number of the transmission projects listed in the 2008-2017 Ten-Year plan can be pushed out further into time without impacting the reliability to existing and new customers. The delayed projects are listed below:

Project Name	**Previous in-service date**	**New in-service date**
Palo Verde Hub-Sun Valley 500kV line	2010	2014
Sun Valley-Trilby Wash 230kV line	2010	2014
Palm Valley-TS2-Trilby Wash 230kV line	2010	2015
Sun Valley-TS9 500kV line	2012	2016
Flagstaff 345/69kV substation	2010	2012
Mazatzal 345/69kV substation	2011	2013
Desert Basin-Pinal Central 230kV line	2011	2013
Sundance-Pinal Central 230kV line	2011	2013
TS12 230/69kV substation	2011	2012
Palo Verde Hub-North Gila #2 500kV line	2012	2014
North Gila-TS8 230kV line	2012	2014
Jojoba 230/69kV substation	2013	TBD
Avery 230/69kV substation	2013	TBD
TS2 230/69kV substation	2011	TBD

* It should be noted that in-service dates shown in this table are based on load projects, not potential interconnections. New generation interconnections may accelerate the in-service date.

New Projects in the 2009-2018 Ten-Year Plan

- Bagdad 115 kV Relocation Project.

  This project is a relocation of an existing 115 kV line. The existing Bagdad 115kV line needs to be relocated due to activities of the mining operation being expanded into the area where the line is currently located.

Conceptual Projects in the Feasibility Planning Phase

The following projects, described below for informational purposes, are still in a preliminary planning phase. These projects will be coordinated with resource options and plans.

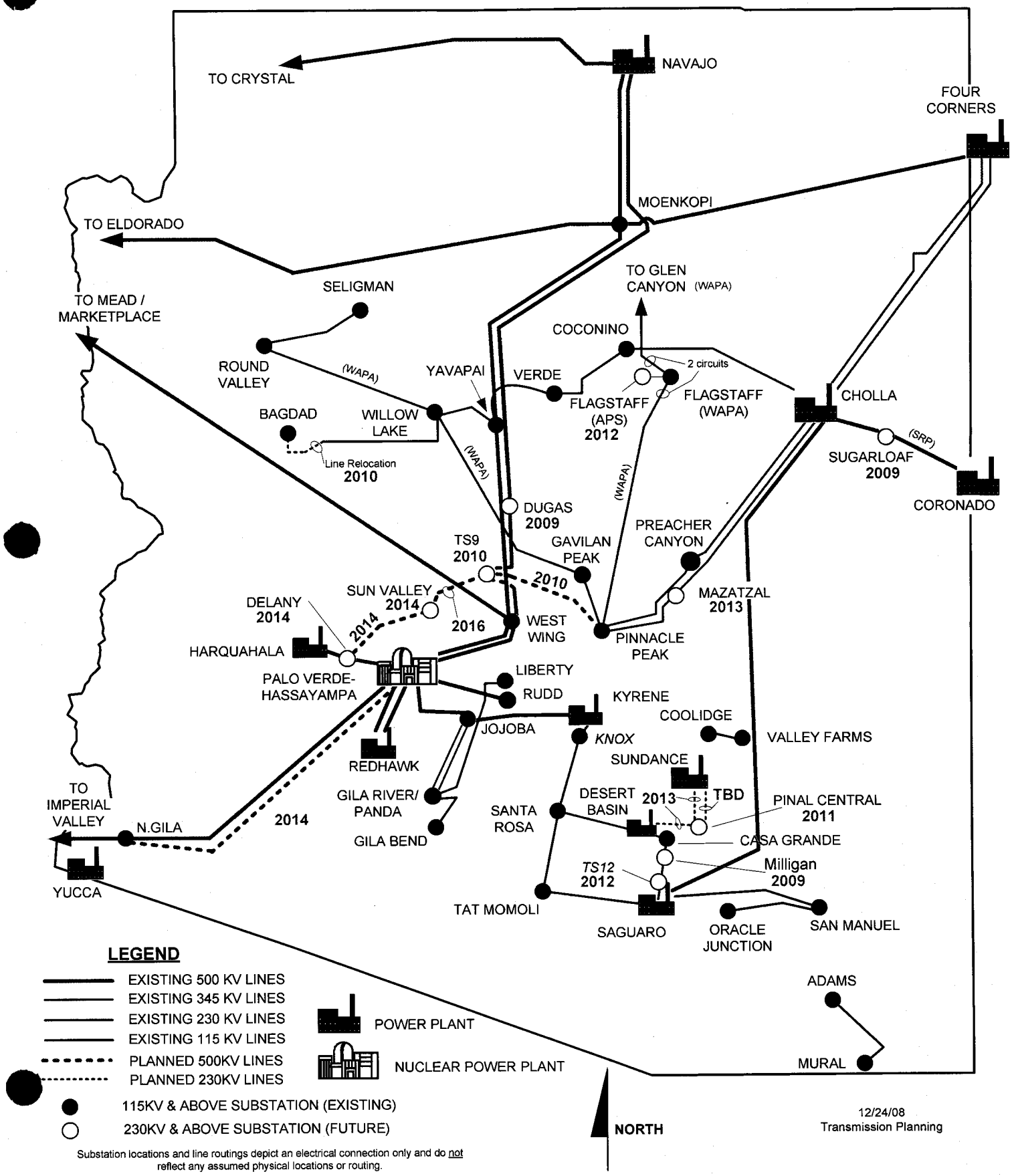
- Northeastern Arizona – Phoenix Metropolitan Area 500kV line

  Additional transmission capacity is being explored between the northeastern area of Arizona and the Phoenix Metropolitan area. It is being studied as a means to provide access to additional resources, specifically wind resources. The scope and timing for this project is still under study.

- Palo Verde Area To Valley Transmission Capacity

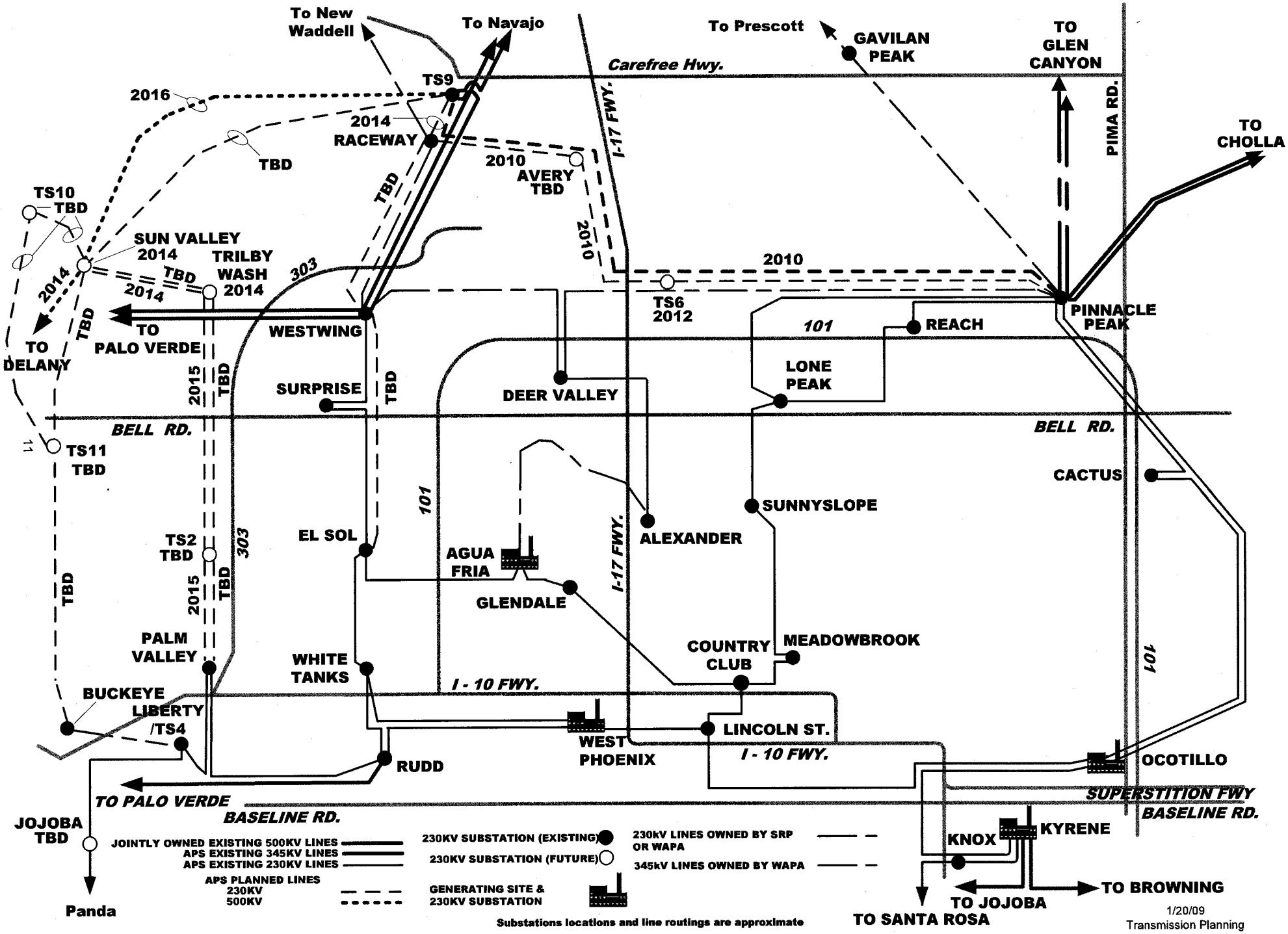
  Additional transmission capacity will be needed from the Palo Verde area (which here includes the Palo Verde, Hassayampa and future Delaney substations as well as the Gila Bend area) to the Phoenix load center. This transmission capacity is a robust component of the overall APS transmission and resource need. The Palo Verde area provides access to existing and potential new gas resources. Additionally, the area around and west of the Palo Verde area contains some of the best solar resource in the country. APS expects that at least a portion of the future solar resources specified in the resource plan will be developed in relatively close proximity to this area and will be supported by this transmission capacity. APS expects to require additional Palo Verde transmission capacity, beyond what is shown in this plan, to deliver these resources to load and currently expects to require this additional capacity in the 2017-2018 timeframe.

APS EHV & OUTER DIVISION 115/230 KV TRANSMISSION PLANS 2009 - 2018

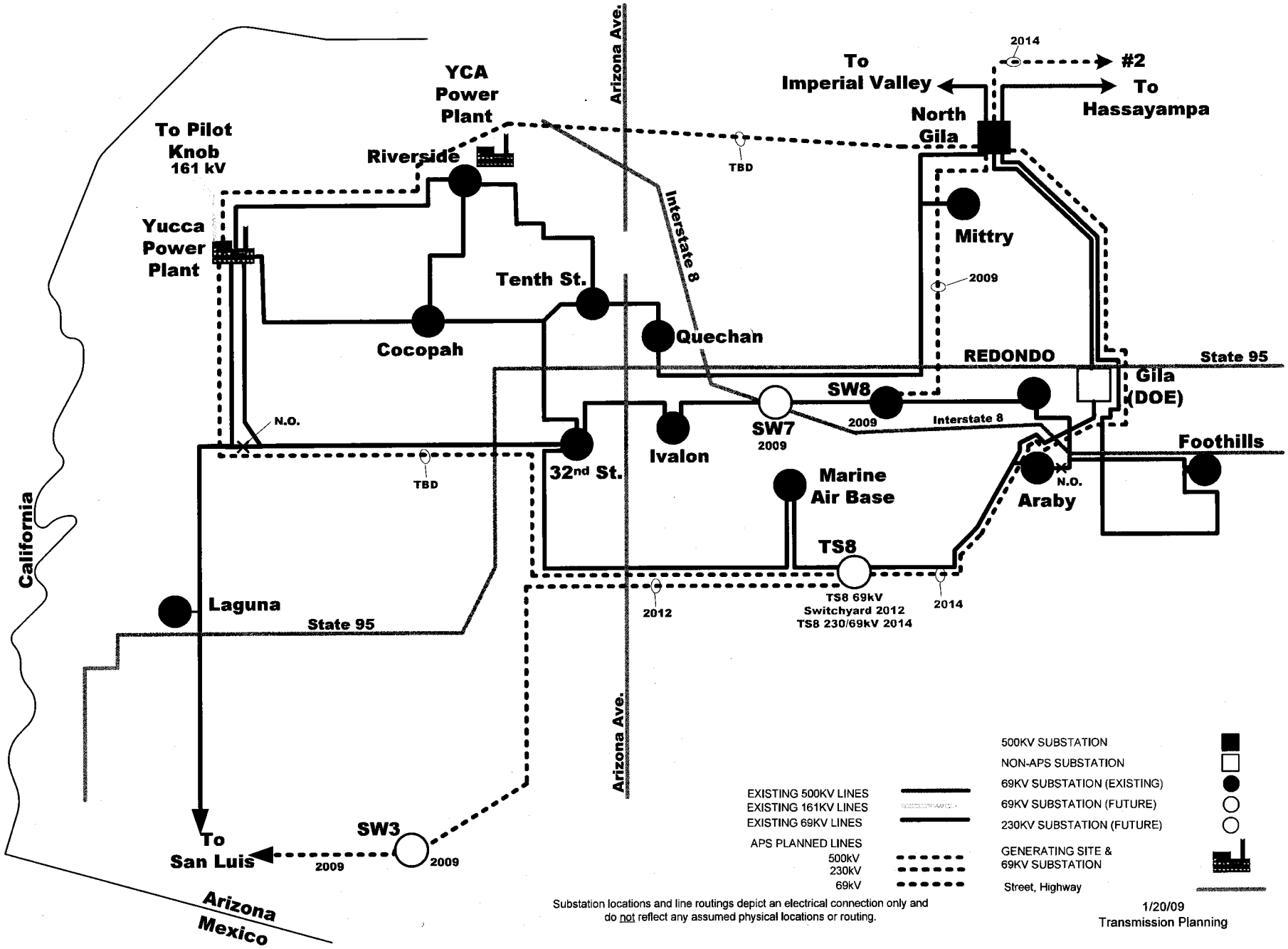


Substation locations and line routings depict an electrical connection only and do not reflect any assumed physical locations or routing.

PHOENIX METROPOLITAN AREA TRANSMISSION PLANS 2009-2018



Yuma Area Transmission Plans 2009- 2018



Project Name: **Sugarloaf loop-in of Coronado - Cholla 500kV line**

Planned In-Service Date: **2009**

Project Sponsor: Arizona Public Service

Other Participants: SRP

Voltage Class: 525kV AC

Facility Rating: 240 MVA

Point of Origin: Coronado - Cholla 500kV line; Sec. 9, T14N, R21E

Point of Termination: Sugarloaf 500/69kV substation to be in-service in 2009; Sec. 9, T14N, R21E

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

The Sugarloaf substation will be constructed adjacent to the existing Coronado-Cholla 500kV line.

Purpose of Project:

This project is needed to provide the electrical source and support to the sub-transmission system to serve the need for electric energy in Show Low and the surrounding communities. The project will improve reliability and continuity of service for the growing communities in the area. The Sugarloaf substation will interconnect into SRP's Coronado-Cholla 500kV line, therefore SRP will construct, own, and operate the new Sugarloaf 500kV switchyard. APS will construct, own, and operate the 500/69kV transformer and 69kV substation.

Schedule:

Construction Start: 2008

In-Service Date: 2009

Permitting / Siting Status:

It is not anticipated that a Certificate of Environmental Compatibility will be needed for this project.

Project Name: **Milligan loop-in of Saguaro-Casa Grande 230kV line**

Planned In-Service Date: **2009**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 188 MVA

Point of Origin: Saguaro-Casa Grande 230kV line; Sec. 18, T8S, R8E

Point of Termination: Milligan substation to be in-service by 2009; Sec. 18, T8S, R8E

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

The Milligan 230/69kV substation will be constructed adjacent to the Saguaro-Casa Grande 230kV line.

Purpose of Project:

This project is needed to provide the electrical source and support to the sub-transmission system to serve the need for electric energy in southern Pinal County, in the Eloy area. The project will also increase the reliability and continuity of service for those areas.

Schedule:

Construction Start: 2008

In-Service Date: 2009

Permitting / Siting Status:

It is not anticipated that a Certificate of Environmental Compatibility will be needed for this project.

Project Name: **Dugas loop-in of Navajo - Westwing 500kV line**

Planned In-Service Date: **2009**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 525kV AC

Facility Rating: 240 MVA

Point of Origin: Navajo-Westwing 500kV line; approximately Sec. 24, T12N, R2E

Point of Termination: Dugas substation to be in-service by 2009; approximately Sec. 24, T12N, R2E

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

The Dugas substation will be constructed adjacent to the Navajo-Westwing line.

Purpose of Project:

This project is needed to provide the electrical source and support to the sub-transmission system to serve the electrical needs in the Verde Valley and Prescott areas. Also, the project will result in increased reliability and continuity of service for the Verde Valley and Prescott areas.

Schedule:

Construction Start: 2008

In-Service Date: 2009

Permitting / Siting Status:

It is not anticipated that a Certificate of Environmental Compatibility will be needed for this project.

Project Name: **Bagdad 115kV Relocation Project**

Planned In-Service Date: **2010**

Project Sponsor: APS

Other Participants: Freeport McMoRan Copper and Gold Inc.

Voltage Class: 115kV AC

Facility Rating: 430 A

Point of Origin: Bagdad Capacitor substation; Sec. 10, T14N, R9W

Point of Termination: Bagdad Mine substation; Sec. 31, T15N, R9W

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 5.5 miles

General Route:

Beginning at the existing APS Capacitor substation and extending in a southwesterly direction for approximately 1.5 miles, then turning in a northwesterly direction approximately 4 miles to the existing Bagdad Mine substation. The project primarily crosses federal BLM lands, private lands (owned by the mine) and a short segment on Arizona State Trust Lands.

Purpose of Project:

Freeport McMoRan Inc. (FMI) has future plans to expand the mine in the location of the existing 115kV transmission line. They have requested that APS move the line in a southerly direction beyond the limits of the planned expansion.

Schedule:

Construction Start: 2009

In-Service Date: 2010

Permitting / Siting Status:

APS plans to file an application for a CEC in the first quarter of 2009.

Project Name: **TS9 - Pinnacle Peak 500kV line**

Planned In-Service Date: **2010**

Project Sponsor: Arizona Public Service

Other Participants: SRP

Voltage Class: 525kV AC

Facility Rating: To be determined

Point of Origin: TS9 substation to be in-service by 2010; Sec. 33, T6N, R1E

Point of Termination: Pinnacle Peak substation; Sec. 10, T4N, R4E

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 26 miles

General Route:

South from TS9 substation approximately 2 miles, generally paralleling the Navajo-Westwing 500kV lines, then turning east at approximately Dove Valley road to approximately Interstate 17. At Interstate 17 the line heads south to Happy Valley road where it turns east to the Pinnacle Peak substation, paralleling the existing 230kV transmission line corridor.

Purpose of Project:

This project is a result of joint planning through the SWAT forum. The project is needed to increase the import capability to the Phoenix Metropolitan area and the export/scheduling capability from the Palo Verde area to provide access to both solar and gas resources. The project also strengthens the transmission system on the east side of the Phoenix Metropolitan valley. The project is anticipated to be a joint participation project with APS as the project manager. The loop-in of the Navajo-Westwing 500kV line into the TS9 substation will be a part of the project. Also, the line will be constructed as 500/230kV double-circuit capable, with the TS9-Raceway-Avery-TS6-Pinnacle Peak 230kV line as the 230kV circuit.

Schedule:

Construction Start: 2008

In-Service Date: 2010

Permitting / Siting Status:

Certificate of Environmental Compatibility issued on 2/13/07 (Case No. 131, Decision No. 69343, TS9-Pinnacle Peak 500/230kV Project).

Project Name: **TS9 - Raceway - Avery - TS6 - Pinnacle Peak 230kV line**

Planned In-Service Date: **2010**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 3000 A

Point of Origin: TS9 230kV substation to be in-service by 2014; Sec. 33, T6N, R1E

Point of Termination: Pinnacle Peak substation; Sec. 10, T4N, R4E

Intermediate Points of Interconnection: Raceway substation; Sec. 4, T5N, R1E
Avery substation in-serviceTBD; Sec. 15, T5N, R2E
TS6 substation to be in-service by 2012; Sec. 8, T4N, R3E

Length of Line (in miles): Approximately 27 miles

General Route:

South from the TS9 substation to the existing Raceway substation, then south from Raceway approximately 1 mile, paralleling existing transmission lines. Then east approximately 9 miles, paralleling Dove Valley Road to the location of the future Avery substation. From Avery the line will continue east along Dove Valley Road to Interstate 17. At Interstate 17 the route will head south 5 miles, generally paralleling the west side of Interstate 17 until Happy Valley Road. The line will turn east, generally parallel to the existing 230kV transmission line corridor, for approximately 10 miles to the existing Pinnacle Peak substation.

Purpose of Project:

This project is needed to serve the need for electric energy in the area immediately north of the Phoenix Metropolitan area and the northern portions of the Phoenix Metropolitan area. Additionally, improved reliability and continuity of service will result for the growing communities in the area; such as Anthem, Desert Hills, New River, and north Phoenix. The in-service date for the 500/230kV transformer at TS9 is currently scheduled for 2014. The in-service date for the TS6 substation is currently scheduled for 2012. The in-service date for the Avery substation is currently outside the ten year planning horizon. The in-service dates for the substations and 500/230kV transformer at TS9 will be continuously evaluated in future planning studies.

Schedule:

Construction Start: 2008

In-Service Date: 2010

Permitting / Siting Status:

Certificate of Environmental Compatibility was issued2/13/07 (Case No. 131, Decision No. 69343, TS9-Pinnacle Peak 500/230kV Project).

Project Name: **345/69kV Interconnection at Western's Flagstaff 345kV bus**

Planned In-Service Date: **2012**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 345kV AC

Facility Rating: 200 MVA

Point of Origin: Western's Flagstaff 345kV substation; Sec. 24, T21N, R9E

Point of Termination: A new Flagstaff 69kV substation to be in-service by 2012; Sec. 24, T21N, R9E

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

A 345/69kV transformer will interconnect into Western's Flagstaff substation.

Purpose of Project:

This project is needed to provide the electrical source and support to the sub-transmission system to serve the need for electric energy in APS's northern service area. The project will provide increased reliability and quality of service for the growing communities in northern Arizona.

Schedule:

Construction Start: 2010

In-Service Date: 2011

Permitting / Siting Status:

It is not anticipated that a Certificate of Environmental Compatibility will be needed for this project.

Project Name: **TS12 loop-in of Saguaro-Casa Grande 230kV line**

Planned In-Service Date: **2012**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 188 MVA

Point of Origin: Saguaro-Casa Grande 230kV line; approximately Sec. 17, T10S, R10E

Point of Termination: TS12 substation to be in-service by 2012; Sec. 17, T10S, R10E

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

The TS12 230/69kV substation will be constructed adjacent to the Saguaro-Casa Grande 230kV line. Approximately 2 miles west of the Saguaro Generating Facility.

Purpose of Project:

This project is needed to provide the electrical source to serve the need for electric energy in southern Pinal County. The project will also increase the reliability and continuity of service for those areas.

Schedule:

Construction Start: 2011

In-Service Date: 2012

Permitting / Siting Status:

It is not anticipated that a Certificate of Environmental Compatibility will be needed for this project.

Project Name: **Desert Basin - Pinal Central 230kV line**

Planned In-Service Date: **2013**

Project Sponsor: Salt River Project

Other Participants: Arizona Public Service

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Desert Basin Power Plant Switchyard; Sec. 13, T6S, R5E

Point of Termination: Pinal Central substation to be in-service by 2011; Sec. 30, T6S, R8E

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 21 miles

General Route:

From the Desert Basin Generation Station, in Casa Grande near Burris and Kortsen Roads, approximately 6 miles generally south and east to a point on the certificated SEV 500kV line near Cornman and Thornton Roads (vicinity of the proposed CATSHV03 Substation). Then the 230kV line will be attached to the 500kV structures for approximately 15 miles to the proposed Pinal Central Substation south of Coolidge, AZ.

Purpose of Project:

The project will improve the reliability of the 230kV system in the region by reducing the loading on existing lines in the area; increase local area system capacity; create one of the 230kV components of the CATS-HV proposed transmission system for the central Arizona area. Also, APS participation in the project, along with APS's Sundance-Pinal Central 230kV line, will allow APS to increase the reliability to deliver the output of the Sundance Generation Facility.

Schedule:

Construction Start: 2010

In-Service Date: 2013

Permitting / Siting Status:

Authority for the portion of the 230kV line to be attached to the 500kV structures is provided for in the CEC granted in Case No. 126, awarded in 2005 (ACC Decision No. 68093 and No. 68291), and subsequently confirmed in Decision No. 69183, which approved SRP's compliance filing for Condition 23 of the CEC. SRP was granted a CEC for Case No. 132 in 2007 (ACC Decision No. 69647) for the approximately six mile portion of the project not previously permitted from Desert Basin Generating Station to the vicinity of Cornman and Thornton Roads south of Casa Grande.

Project Name: **Sundance - Pinal Central 230kV line**

Planned In-Service Date: **2013**

Project Sponsor: Arizona Public Service

Other Participants: ED-2

Voltage Class: 230kV AC

Facility Rating: 3000 A

Point of Origin: Sundance substation; Sec. 2, T6S, R7E

Point of Termination: Pinal Central substation to be in-service by 2011; Sec. 30, T6S, R8E

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 6 miles

General Route:

The project will originate at a new substation on the Sundance property, proceeding west and then south along Curry Road to the half-section between State Route 287 and Earley Road. The final west to east alignment connecting into the Pinal Central Substation will be located within an ACC-approved corridor and is subject to further design and right-of-way acquisition analysis.

Purpose of Project:

This project will serve increasing loads in Pinal County, and throughout the APS system, and will improve reliability and continuity of service for the growing communities in the area. Also, the project will increase the reliability of Sundance by providing a transmission line in a separate corridor than the existing lines that exit the plant. This project, in conjunction with the Desert Basin-Pinal Central 230kV project, will allow APS to reliably and economically deliver energy from Sundance over APS's transmission system. The project will be constructed as a 230kV double-circuit capable line, but initially operated as a single-circuit. The in-service date for the second circuit will be evaluated in future planning studies.

Schedule:

Construction Start: 2011

In-Service Date: 2013

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 4/29/08 (Case No. 136, Decision No. 70325, Sundance to Pinal South 230kV Transmission Line project).

Project Name: **Mazatzal loop-in of Cholla-Pinnacle Peak 345kV line**

Planned In-Service Date: **2013**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 345kV AC

Facility Rating: 200 MVA

Point of Origin: Cholla-Pinnacle Peak or Preacher Canyon-Pinnacle Peak 345kV line; near Sec. 3, T8N, R10E

Point of Termination: Mazatzal substation to be in-service by 2013; Sec. 3, T8N, R10E

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

The Mazatzal 345/69kV substation will be constructed adjacent to the Cholla-Pinnacle Peak 345kV line corridor.

Purpose of Project:

This project is needed to provided the electric source and support to the sub-transmission system to serve the need for electric energy in the area of Payson and the surrounding communities. Additionally, improved reliability and continuity of service will result for the growing communities in the Payson area.

Schedule:

Construction Start: 2012

In-Service Date: 2013

Permitting / Siting Status:

It is not anticipated that a Certificate of Environmental Compatibility will be needed for this project.

Project Name: **Palo Verde Hub - Sun Valley 500kV line**

Planned In-Service Date: **2014**

Project Sponsor: Arizona Public Service

Other Participants: SRP, CAWCD

Voltage Class: 525kV AC

Facility Rating: To be determined

Point of Origin: Palo Verde Switchyard or a new switchyard at Arlington Valley Energy Facility.

Point of Termination: Sun Valley substation to be in-service by 2014; Sec. 29, T4N, R4W

Intermediate Points of Interconnection: Proposed Delany switching station; approximately Sec. 25, T2N, R8W

Length of Line (in miles): Approximately 45 miles

General Route:

Generally leaving the Palo Verde Hub vicinity following the Palo Verde-Devers #1 and the Hassayampa-Harquahala 500kV lines until crossing the CAP canal. Then easterly, generally following the CAP canal, on the north side of the canal to the new Sun Valley substation.

Purpose of Project:

This project is needed to serve projected need for electric energy in the area immediately north and west of the Phoenix Metropolitan area. It will increase the import capability to the Phoenix Metropolitan area as well as increase the export/ scheduling capability from the Palo Verde area to provide access to both solar and gas resources. The project will also increase the system reliability by providing a new transmission source to help serve the growing areas in the western portions of the Phoenix Metropolitan area. This is a joint participation project with APS as the project manager. The initial plan of service for the project will be a 500kV line between the Delany switchyard and the Sun Valley substation. The Delany switchyard will interconnect into the existing Hassayampa-Harquahala 500kV line.

Schedule:

Construction Start: 2011

In-Service Date: 2014

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 8/17/05 (Case No. 128, Decision No. 68063, Palo Verde Hub to TS5 500kV Transmission project). APS, as project manager, holds the CEC.

Project Name: **Sun Valley - Trilby Wash 230kV line**

Planned In-Service Date: **2014**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 3000 A

Point of Origin: Sun Valley substation to be in-service by 2014; Sec. 29, T4N, R4W

Point of Termination: Trilby Wash substation to be in-service by 2014; Sec. 20, T4N, R2W

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 15 miles

General Route:

East from the Sun Valley substation along the CAP canal to approximately 243rd Ave., south to the existing 500kV transmission line corridor, and then east along the corridor to the Trilby Wash substation.

Purpose of Project:

This project is required to serve the need for electric energy in the western Phoenix Metropolitan area. Also, the project will provide more capability to import power into the Phoenix Metropolitan area along with improved reliability and continuity of service for growing communities in the area; such as El Mirage, Surprise, Youngtown, Buckeye, and unincorporated Maricopa county. The first circuit is scheduled to be in-service for the summer of 2014 and the in-service date for the second circuit will be evaluated in future planning studies.

Schedule:

Construction Start: 2012

In-Service Date: 2014

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 5/5/05 (Case No. 127, Decision No. 67828, West Valley North 230kV Transmission Line project).

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Project Name: **Palo Verde Hub - North Gila 500kV #2 line**

Planned In-Service Date: **2014**

Project Sponsor: Arizona Public Service

Other Participants: SRP, IID, WMIDD

Voltage Class: 525kV AC

Facility Rating: To be determined

Point of Origin: Hassayampa switchyard, Arlington Valley Power Plant, or Redhawk Power Plant

Point of Termination: North Gila substation; Sec. 11, T8S, R22W

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 110 miles

General Route:

This line will generally follow the route of the existing Hassayampa - North Gila 500kV #1 line.

Purpose of Project:

This project will increase the import capability for the Yuma area and export/scheduling capability from the Palo Verde area to provide access to both solar and gas resources. This is a joint participation project with APS as the project manager.

Schedule:

Construction Start: 2011

In-Service Date: 2014

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 1/23/08 (Case No. 135, Decision No. 70127, Palo Verde Hub to North Gila 500kV Transmission Line project).

Project Name: **North Gila - TS8 230kV line**

Planned In-Service Date: **2014**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 3000 A

Point of Origin: North Gila substation; Sec. 11, T8S, R22W

Point of Termination: TS8 230kV substation to be in-service by 2014; Sec. 25, T9S, R23W

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 15 miles

General Route:

The routing for this line has not yet been determined.

Purpose of Project:

This project is needed to serve the need for electric energy, improved reliability, and continuity of service for the greater Yuma area.

Schedule:

Construction Start: 2012

In-Service Date: 2014

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility has not yet been filed.

Project Name: **Palm Valley - TS2 - Trilby Wash 230kV line**

Planned In-Service Date: **2015**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 3000 A

Point of Origin: Palm Valley substation; Sec. 24, T2N, R2W

Point of Termination: Trilby Wash substation to be in-service by 2014; Sec. 20, T4N, R2W

Intermediate Points of Interconnection: TS2 substation to be in-service by TBD; Sec. 25, T3N, R2W

Length of Line (in miles): Approximately 12 miles

General Route:

North from the Palm Valley substation, generally following the Loop 303 to Cactus road, west on Cactus road to approximately 191st Avenue, and then north on 191st Avenue to the Trilby Wash substation.

Purpose of Project:

This project is required to serve the need for electric energy in the western Phoenix Metropolitan area. The project provides more capability to import power into the Phoenix Metropolitan area and by providing a second 230kV source for Trilby Wash it provides improved system reliability and continuity of service for growing communities in the area; such as El Mirage, Surprise, Youngtown, Goodyear, and Buckeye. The first circuit is scheduled to be in-service for the summer of 2015 and the in-service date for the second circuit will be evaluated in future planning studies. The in-service date for the TS2 substation is currently outside of the ten year planning horizon. The in-service date for the substation will be continuously evaluated in future planning studies.

Schedule:

Construction Start: 2012

In-Service Date: 2015

Permitting / Siting Status:

The Palm Valley-TS2 230kV line portion was sited as part of the West Valley South 230kV Transmission Line project and a Certificate of Environmental Compatibility was issued 12/24/03 (Case No. 122, Decision No. 66646). The Trilby Wash-TS2 230kV line portion was sited as part of the West Valley North 230kV Transmission Line project and a Certificate of Environmental Compatibility was issued 5/5/05 (Case No. 127, Decision No. 67828).

Project Name: **Sun Valley - TS9 500kV line**

Planned In-Service Date: **2016**

Project Sponsor: Arizona Public Service

Other Participants: SRP, CAWCD

Voltage Class: 525kV AC

Facility Rating: To be determined

Point of Origin: Sun Valley substation to be in-service in 2014; Sec. 29, T4N, R4W

Point of Termination: TS9 substation to be in-service in 2010; Sec. 33, T6N, R1E

Intermediate Points of Interconnection:

Length of Line (in miles): To be determined

General Route:

The route for this project has not yet been determined. Generally the line will head north-northeast out of the Sun Valley substation and then east to the TS9 substation.

Purpose of Project:

This project is needed to serve the need for electric energy in the Phoenix Metropolitan area. It will increase the import capability to the Phoenix Metropolitan area, as well as increase the export/scheduling capability from the Palo Verde area, which includes both solar and gas resources. The project will also increase the reliability of the EHV system by completing a 500kV loop that connects the Palo Verde Transmission system, the Southern Navajo Transmission system, and the Southern Four Corners system. In addition the project will also increase reliability by providing a second 500kV source for the Sun Valley substation and providing support for multiple Category C and D transmission contingencies. This project is anticipated to be 500/230kV double-circuit capable.

Schedule:

Construction Start: 2013

In-Service Date: 2016

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility was filed 7/1/08 (Case No. 138) and approved by the Arizona Power Plant and Line Siting Committee on 12/2/08. The ACC is expected to vote on the CEC application during the first quarter of 2009.

Project Name: **Jojoba loop-in of TS4-Panda 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: 188 MVA

Point of Origin: TS4-Panda 230kV line; Sec. 25, T2S, R4W

Point of Termination: Jojoba 230/69 substation with an in-service TBD; Sec. 25, T2S, R4W

Intermediate Points of Interconnection:

Length of Line (in miles): Less than 1 mile

General Route:

The Jojoba 230/69kV substation will be constructed adjacent to the TS4-Panda 230kV line.

Purpose of Project:

This project is needed to provide the electrical source and support to the sub-transmission system to serve the need for electric energy for the growing communities in the area; such as Buckeye, Goodyear, and Gila Bend. The project will also increase the reliability and continuity of service for those areas.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 10/16/00 (Case No. 102, Decision No. 62960, Gila River Transmission Project) for the Gila River Transmission Project included the interconnection of the 230kV substation.

Project Name: **North Gila - Yucca 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: North Gila substation; Sec. 11, T8S, R22W

Point of Termination: Yucca substation; Sec. 36, T7S, R24W

Intermediate Points of Interconnection:

Length of Line (in miles): To be determined

General Route:

The routing for this line has not yet been determined.

Purpose of Project:

This project is needed to serve the need for electric energy, improved reliability, and continuity of service for the greater Yuma area.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility has not yet been filed.

Project Name: **Yucca - TS8 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Yucca substation; Sec. 36 , T7S, R24W

Point of Termination: TS8 substation to be in-service in 2014; Sec. 25, T9S, R23W

Intermediate Points of Interconnection:

Length of Line (in miles): To be determined

General Route:

The routing for this line has not yet been determined.

Purpose of Project:

This project is needed to serve the need for electric energy, improved reliability, and continuity of service for the greater Yuma area.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility has not yet been filed.

Project Name: **Sun Valley - TS10 - TS11 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Sun Valley substation to be in-service by 2014; Sec. 29, T4N, R4W

Point of Termination: A future TS11 substation; location to be determined

Intermediate Points of Interconnection: A future TS10 substation; location to be determined

Length of Line (in miles): To be determined

General Route:

The route for this project has not yet been determined.

Purpose of Project:

This project will be needed to provide a transmission source to serve future load that emerges in the currently undeveloped areas northwest of the White Tank Mountains. This line is anticipated to be a 230kV line emanating from the Sun Valley substation, with the future TS10 230/69kV substation to be interconnected into the 230kV line.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility has not yet been filed.

Project Name: **Sun Valley - TS11 - Buckeye 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Sun Valley substation to be in-service by 2014; Sec. 29, T4N, R4W

Point of Termination: Buckeye substation; Sec. 7, T1N, R3W

Intermediate Points of Interconnection: A future TS11 substation; location to be determined

Length of Line (in miles): To be determined

General Route:

The routing for this line has not yet been determined.

Purpose of Project:

This project is needed to serve the need for electric energy in the largely undeveloped areas west of the White Tank Mountains. This project will provide the first portion of the transmission infrastructure in this largely undeveloped area and provides a transmission connection between the northern and southern transmission sources that will serve the area. Improved reliability and continuity of service will result for this portion of Maricopa County. It is anticipated that this project will be constructed with double-circuit capability, but initially operated as a single circuit. The in-service date and location of the TS11 230/69kV substation will be determined in future planning studies based upon the development of the area.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility has not yet been filed.

Project Name: **Sun Valley - TS9 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Sun Valley substation to be in-service in 2014; Sec. 29, T4N, R4W

Point of Termination: TS9 substation to be in-service in 2010; Sec. 33, T6N, R1E

Intermediate Points of Interconnection: To be determined

Length of Line (in miles): To be determined

General Route:

The route for this project has not yet been determined. Generally the line will head north-northeast out of the Sun Valley substation and then east to the TS9 substation.

Purpose of Project:

This project will be needed to provide a transmission source to serve future load that emerges in the currently undeveloped areas south and west of Lake Pleasant. This line is anticipated to be the 230kV circuit on the Sun Valley-TS9 500/230kV double-circuit line.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

An application for a Certificate of Environmental Compatibility was filed 7/1/08 (Case No. 138) and approved by the Arizona Power Plant and Line Siting Committee on 12/2/08. The ACC is expected to vote on the CEC application during the first quarter of 2009.

Project Name: **Westwing - Raceway 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Westwing substation; Sec. 12, T4N, R1W

Point of Termination: Raceway substation; Sec. 4, T5N, R1E

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 7 miles

General Route:

Northeast from Westwing substation paralleling existing transmission lines to the Raceway 230kV substation.

Purpose of Project:

This project will serve the need for electric energy in the far north and northwest parts of the Phoenix Metropolitan area and provide contingency support for multiple Westwing 500/230kV transformer outages. The in-service date will continue to be evaluated in future planning studies.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 6/18/03 (Case No. 120, Decision No. 64473, North Valley 230kV Transmission Line Project).

Project Name: **Westwing - El Sol 230kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: Arizona Public Service

Other Participants: None

Voltage Class: 230kV AC

Facility Rating: To be determined

Point of Origin: Westwing substation; Sec. 12, T4N, R1W

Point of Termination: El Sol substation; Sec. 30, T3N, R1E

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 11 miles

General Route:

Per certificate. Generally following the existing Westwing-Surprise-El Sol 230kV corridor.

Purpose of Project:

This project will increase system capacity to serve growing demand for electric energy in the Phoenix Metropolitan area, while maintaining system reliability and integrity for delivery of bulk power from Westwing south into the APS Phoenix Metropolitan area 230kV transmission system.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 7/26/73 (Case No. 9, Docket No. U-1345). Note that this Certificate authorizes two double-circuit lines. Construction of the first double-circuit line was completed in March 1975. Construction of the second line, planned to be built with double-circuit capability, but initially operated with a single circuit, is described above.

Project Name: **Palo Verde - Saguaro 500kV line**

Planned In-Service Date: **To be determined**

Project Sponsor: CATS Sub-Regional Planning Group Participants

Other Participants: To be determined

Voltage Class: 525kV AC

Facility Rating: To be determined

Point of Origin: Palo Verde switchyard; Sec. 34, T1N, R6W

Point of Termination: Saguaro substation; Sec. 14, T10S, R10E

Intermediate Points of Interconnection:

Length of Line (in miles): Approximately 130 miles

General Route:

Generally south and east from the Palo Verde area to a point near Gillespie Dam, then generally easterly until the point at which the Palo Verde-Kyrene 500kV line diverges to the north and east. The corridor then is generally south and east again, adjacent to a gas line corridor, until meeting up with the Tucson Electric Power Company's Westwing-South 345kV line. The corridor follows the 345kV line until a point due west of the Saguaro Generating Station. The corridor then follows a lower voltage line into the 500kV yard just south and east of the Saguaro Generating Station.

Purpose of Project:

This line is the result of the joint participation CATS study. The line will be needed to increase the adequacy of the existing EHV transmission system and permit increased power delivery throughout the state.

Schedule:

Construction Start: TBD

In-Service Date: TBD

Permitting / Siting Status:

Certificate of Environmental Compatibility issued 1/23/1976 (Case No. 24, Decision No. 46802).

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TRANSMISSION PLANNING PROCESS AND GUIDELINES

APS Transmission Planning

January 2009

TRANSMISSION PLANNING PROCESS AND GUIDELINES

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I. INTRODUCTION AND PURPOSE

The Transmission Planning Process and Guidelines (Guidelines) are used by Arizona Public Service Company (APS) to assist in planning its Extra High Voltage (EHV) transmission system (345kV and 500kV) and High Voltage transmission system (230kV and 115kV). In addition to these Guidelines, APS follows the Western Electricity Coordinating Council's (WECC) regional planning reliability criteria for system disturbance and performance levels. These WECC Reliability Criteria are (1) WECC/NERC Reliability Criteria for Transmission System Planning and (2) Minimum Operating Reliability Criteria, which can be found in their entirety on the WECC website; (http://www.wecc.biz/documents/library/procedures/CriteriaMaster.pdf). These Guidelines are for internal use by APS and may be changed or modified. Thus, others should not use these Guidelines without consultation with APS.

II. PLANNING METHODOLOGY

A. General

APS uses a deterministic approach for transmission system planning. Under this approach, system performance should meet certain specific criteria under normal conditions (all lines in-service) and for any single contingency condition (any one element out-of-service). In general, an adequately planned transmission system will:

- Provide an acceptable level of service that is cost-effective for normal and single contingency operating conditions.
- Maintain service to all firm loads for any single contingency outage; except for radial loads.
- Not result in overloaded equipment or unacceptable voltage conditions for single contingency outages.
- Not result in cascading for single or double contingency outages.
- Provide for the proper balance between the transmission import capability and local generation requirements for an import limited load area.

Although APS uses a deterministic approach for transmission system planning, the WECC reliability planning criteria provides for exceptions based upon a probalistic approach. APS uses these probabilistic criteria when/where appropriate in the transmission planning process. Historical system reliability performance is analyzed on a periodic basis and the results are used in the design of planned facilities.

These planning methodologies, assumptions, and guidelines are used as the basis for the development of future transmission facilities. Additionally, consideration of potential alternatives to transmission facilities (such as distributed generation or new technologies) is evaluated on a case-specific basis.

As new planning tools and/or information become available revisions or additions to these guidelines will be made as appropriate.

B. Transmission Planning Process

APS' transmission planning process consists of an assessment of the following needs:

- Provide adequate transmission to access designated network resources in-order to reliably and economically serve all network loads.
- Support APS' and other network customers' local transmission and sub-transmission systems.
- Provide for interconnection for new resources.
- Accommodate requests for long-term transmission access.

During this process, consideration is given to load growth patterns, other system changes affected by right-of-way, facilities siting constraints, routing of future transportation corridors, and joint planning with neighboring utilities, governmental entities, and other interested stakeholders (see APS OATT Attachment (E).

1. EHV Transmission Planning Process

APS' EHV transmission system, which consists of 500kV and 345kV, has primarily been developed to provide transmission to bring the output of large base-loaded generators to load centers, such as Phoenix. Need for new EHV

facilities may result from any of the bullet items described above. APS' annual planning process includes an assessment of APS' transmission capability to ensure that designated network resources can be accessed to reliably and economically serve all network loads. In addition, biennial RMR studies are performed to ensure that proper balance between the transmission import capability and local generation requirements for an import limited load area are maintained.

2. 230kV Transmission Planning Process

APS' 230kV transmission system has primarily been developed to provide transmission to distribute power from the EHV bulk power substations and local generators to the distribution system and loads throughout the load areas.

Planning for the 230kV system assesses the need for new 230/69kV substations to support local sub-transmission and distribution system growth and the reliability performance of the existing 230kV system. This process takes into account the future land use plans that were developed by government agencies, Landis aerial photo maps, master plans that were provided by private developers, and APS' long-range forecasted load densities per square mile for residential, commercial, and industrial loads.

3. Transmission Facilities Required for Generation/Resource Additions

New transmission facilities may also be required in conjunction with generation resources due to (1) a "merchant" request by an Independent Power Producer (IPP) for generator interconnection to the APS system, (2) a "merchant" request for point-to-point transmission service from the generator (receipt point) to the designated delivery point, or (3) designation of new resources or re-designation of existing units to serve APS network load (including removal of an older units' native load designation). These studies/processes are performed pursuant to the APS Open Access Transmission Tariff (OATT).

C. Ten Year Transmission System Plans

Each year APS uses the planning process described in section B to update the Ten-Year Transmission System Plan. The APS Ten Year Transmission System Plan identifies all new transmission facilities, 115kV and above, and all facility replacements/upgrades required over the next ten years to reliably and economically serve the load.

D. Regional Coordinated Planning

1. Western Electricity Coordinating Council (WECC)

APS is a member of the Western Electricity Coordinating Council. The focus of the WECC is on promoting the reliability of the interconnected bulk electric system. The WECC provides the means for:

- Developing regional planning and operating criteria.
- Coordinating future plans.
- Compiling regional data banks for use by the member systems and the WECC in conducting technical studies.
- Assessing and coordinating operating procedures and solutions to regional problems.
- Establishing an open forum with interested non-project participants to review the plan of service for a project.
- Through the WECC Transmission Expansion Policy Committee, performing economic transmission congestion analysis.

APS works with WECC to adhere to these planning practices.

2. Sub-Regional Planning Groups

Southwest Area Transmission Planning (SWAT) and other sub-regional planning groups provide a forum for entities within a region, and any other interested parties, to determine and study the needs of the region as a whole. It also provides a forum for specific projects to be exposed to potential partners and allows for joint studies and participation from interested parties.

3. WestConnect

APS and the other WestConnect members executed the WestConnect Project Agreement for Subregional Transmission Planning in May of 2007. This agreement promotes coordination of regional transmission planning for the WestConnect planning area by formalizing a relationship among the WestConnect members and the WestConnect area sub-regional planning groups including SWAT. The agreement provides for resources and funding for the development of a ten year integrated regional transmission plan for the WestConnect planning area. The agreement also ensures that the WestConnect transmission planning process will be coordinated and integrated with other planning processes within the Western Interconnection and with the WECC planning process.

4. Joint Studies

In many instances, transmission projects can serve the needs of several utilities and/or IPPs. To this end, joint study efforts may be undertaken. Such joint study efforts endeavor to develop a plan that will meet the needs and desires of all individual companies involved.

E. Generation Schedules

For planning purposes, economic dispatches of network resources are determined for APS' system peak load in the following manner:

a. Determine base generation available and schedule these units at maximum output.
b. Determine resources purchased from other utilities, IPPs, or power marketing agencies.
c. Determine APS' spinning reserve requirements.
d. Schedule intermediate generation (oil/gas steam units) such that the spinning reserve requirements, in section (c) above, are met.
e. Determine the amount of peaking generation (combustion turbine units) required to supply the remaining system peak load.

Phoenix area network resources are dispatched based on economics and any existing import limitations. When possible, spinning reserve will be carried on higher cost Phoenix area network generating units.

Generation output schedules for interconnected utilities and IPPs are based upon consultation with the neighboring utilities and IPPs or as modeled in the latest data in WECC coordinated study cases.

F. Load Projections

APS substation load projections are based on the APS Corporate Load Forecast. Substation load projections for neighboring interconnected utilities or power agencies operating in the WECC area are based on the latest data in WECC coordinated study cases. Heavy summer loads are used for the Ten-Year Transmission System Plans.

G. Alternative Evaluations

1. General

In evaluating several alternative plans, comparisons of power flows, transient stability tests, and fault levels are made first. After the alternatives are found that meet the system performance criteria in each of these three areas comparisons may be made of the losses, transfer capability, impact on system operations, and reliability of each of the plans. Finally, the costs of facility additions (capital cost items), costs of losses, and relative costs of transfer capabilities are determined. A brief discussion of each of these considerations follows.

2. Power Flow Analyses

Power flows of base case (all lines in-service) and single contingency conditions are tested and should conform to the system performance criteria set forth in Section IV of these Guidelines. Double or multiple contingencies are examined, but in general, no facilities are planned for such conditions. Normal system voltages, voltage deviations, and voltage extreme limitations are based upon operating experience resulting in acceptable voltage levels to

the consumer. Power flow limits are based upon the thermal ratings and/or sag limitations of conductors or equipment, as applicable.

3. Transient Stability Studies

   Stability guidelines are established to maintain system stability for single contingency, three-phase fault conditions. Double or multiple contingencies are examined, but in general, no facilities are planned for such conditions.

4. Short Circuit Studies

   Three-phase and single-phase-to-ground fault studies are performed to ensure the adequacy of system protection equipment to clear and isolate faults.

5. Reactive Power Margin Analyses

   Reactive Power Margin analyses are performed when steady-state analyses indicate possible insufficient voltage stability margins. V-Q curve analyses are used to determine post-transient voltage stability.

6. Losses Analyses

   A comparison of individual element and overall transmission system losses are made for each alternative plan being studied. The losses computed in the power flow program consist of the I^2R losses of lines and transformers and the core losses in transformers, where represented.

7. Transfer Capability Studies

   In evaluating the relative merits of one or more EHV transmission plans, both simultaneous and non-simultaneous transfer capability studies are performed to determine the magnitude of transfer capabilities between areas or load centers.

8. Subsynchronous Resonance (SSR)

   SSR phenomenon result from the use of series capacitors in the network where the tuned electrical network exchanges energy with a turbine generator at one or more of the natural frequencies of the mechanical system. SSR countermeasures are applied to prevent damage to machines as a result of transient current or sustained oscillations following a system disturbance. SSR studies are not used directly in the planning process. SSR countermeasures are determined after the transmission plans are finalized.

9. FACTS (Flexible AC Transmission System)

FACTS devices are a recent application of Power Electronics to the transmission system. These devices make it possible to use circuit reactance, voltage magnitude and phase angle as control parameters to redistribute power flows and regulate bus voltages, thereby improving power system operation. FACTS devices can provide series or shunt compensation. These devices can be used as a controllable voltage source in series or as a controllable current source in shunt mode to improve the power transmission system operations. FACTS will be evaluated as a means of power flow control and/or to provide damping to dynamic oscillations where a need is identified and it is economically justified.

10. Economic Evaluation

In general, an economic evaluation of alternative plans consists of a cumulative present worth or equivalent annual cost comparison of capital costs.

III. PLANNING ASSUMPTIONS

A. General

1. Loads

Loads used for the APS system originate from the latest APS Corporate Load Forecast. In most cases, the corrected power factor of APS loads is 99.5% at 69kV substations.

2. Generation and Other Resources

Generation dispatch is based on firm power and/or transmission wheeling contracts including network resources designations.

3. Normal Voltage Levels

a. Nominal EHV design voltages are 500kV, 345kV, 230kV, and 115kV.

b. Nominal EHV operating voltages are 535kV, 348kV, 239kV, and 119kV.

4. Sources of Databases

WECC Heavy Summer base cases are the sources of the databases. Loop flow (unscheduled flow), of a reasonable amount and direction, will be allowed for use in planning studies.

5. Voltage Control Devices

Devices which can control voltages are shunt capacitors, shunt reactors, tap-changing-under-load (TCUL) and fixed-tap transformers, static VAR compensators, and machine VAR capabilities. If future voltage control devices are necessary, these devices will be evaluated based upon economics and the equipment's ability to obtain an adequate voltage profile on the EHV and HV systems.

6. Phase Shifters

In general, where phase shifters are used, schedules are held across the phase shifter in base case power flows and the phase shifter tap remains fixed in the outage cases.

7. Conductor Sizes

Existing transmission voltages utilized by APS are 230kV, 345kV, and 500kV. It is presently planned that the 345kV transmission system will not be expanded, thus all future APS EHV lines will be 500kV or 230kV. Planned 500kV lines will initially be modeled using tri-bundled 1780 kCM ACSR conductor (Chukar). Preferred construction for 230kV lines consists of 2156 kCM ACSS conductor on steel poles.

8. 69kV System Modeling

230kV facility outages may result in problems to the underlying 69kV system due to the interconnection of those systems. For this reason, power flow cases include a detailed 69kV system representation. Solutions to any problems encountered on the 69kV system are coordinated with the subtransmission planning engineers.

9. Substation Transformers

a. 500kV and 345kV Substations

Bulk substation transformer banks may be made up of one three-phase or three single-phase transformers, depending upon bank size and economics. For larger banks where single-phase transformers are used, a fourth (spare) single-phase transformer will be used in a jack-bus arrangement to improve reliability and facilitate connection of the spare in the event of an outage of one of the single-phase transformers. TCUL will be considered in the high voltage windings, generally with a range of plus or minus 10%. High voltage ratings will be 500kV or 345kV class and low voltage windings will be 230kV, 115kV, or 69kV class.

b. 230kV Substations

For high-density load areas, both 230/69kV and 69/12.5kV transformers can be utilized. 230/69kV transformers will be rated at 113/150/188 MVA with a 65°C temperature rise, unless otherwise specified. 69/12.5kV transformers will be rated at 25/33/41 MVA with a 65°C temperature rise, unless otherwise specified.

With all elements in service, a transformer may be loaded up to its top Forced Oil Air (FOA) rating without sustaining any loss of service life. For a single contingency outage (loss of one transformer) the remaining transformer or transformers may be loaded up to 20% above their top FOA rating, unless heat test data indicate a different overload capability. The loss of service life sustained will depend on the transformer pre-loading and the outage duration. Tap setting adjustment capabilities on 230/69kV transformers will be ±5% from the nominal voltage setting (230/69kV) at 2½% increments.

10. Switchyard Arrangements

a. 500kV and 345kV Substations

Existing 345kV switchyard arrangements use breaker-and-one-half, main-and-transfer, or modified paired-element circuit breaker switching

schemes. Because of the large amounts of power transferred via 500kV switchyards and the necessity of having adequate reliability, all 500kV circuit breaker arrangements are planned for an ultimate breaker-and-one-half scheme. If only three or four elements are initially required, the circuit breakers are connected in a ring bus arrangement, but physically positioned for a breaker-and-one-half scheme. The maximum desired number of elements to be connected in the ring bus arrangement is four. System elements such as generators, transformers, and lines will be arranged in breaker-and-one-half schemes such that a failure of a center breaker will not result in the loss of two lines routed in the same general direction and will minimize the impact of losing two elements.

b. 230kV Substations

Future 230/69kV substations should be capable of serving up to 452 MVA of load. 400 MVA has historically been the most common substation load level in the Phoenix Metropolitan area. Future, typical 230/69kV substations should accommodate up to four 230kV line terminations and up to three 230/69kV transformer bays. Based upon costs, as well as reliability and operating flexibility considerations, a breaker-and-one-half layout should be utilized for all future 230/69kV Metropolitan Phoenix Area substations, with provision for initial development to be a ring bus. Any two 230/69kV transformers are to be separated by two breakers, whenever feasible, so that a stuck breaker will not result in an outage of both transformers.

11. Series Capacitor Application

Series capacitors may be used on EHV lines to increase system stability, for increased transfer capability, and/or for control of power flow. The series capacitors may be lumped at one end of a line because of lower cost; however, the capacitors are generally divided into two banks, one at either end of a line, for improved voltage profile.

12. Shunt and Tertiary Reactor Application

Shunt and/or tertiary reactors may be installed to prevent open end line voltages from being excessive, in addition to voltage control. The open end line voltage must not be more than 0.05 per unit voltage greater than the sending end voltage. Tertiary reactors may also be used for voltage and VAR control as discussed above.

B. Power Flow Studies

1. System Stressing

Realistic generation capabilities and schedules should be used to stress the transmission system in order to maximize the transfer of resources during the maximum load condition.

2. Displacement

In cases where displacements (due to power flow opposite normal generation schedules) may have an appreciable effect on transmission line loading, a reasonable amount of displacement (Generation Units) may be removed in-order to stress a given transmission path.

C. Transient Stability Studies

1. Fault Simulation

When studying system disturbances caused by faults, two conditions will be simulated:

a. Three-phase-to-ground faults, and
b. Single-line-to-ground faults with a stuck circuit breaker in one phase with back-up delayed clearing.

2. Margin

a. Generation margin may be applied for the contingencies primarily affected by generation, or
b. Power flow margin may be applied for the contingencies primarily affected by power flow.

3. Unit Tripping

Generator unit tripping may be allowed in-order to increase system stability performance.

4. Machine Reactance Representation

For transient stability studies, the unsaturated transient reactance of machines with full representation will be used.

5. Fault Damping

Fault damping will be applied to the generating units adjacent to faults. Fault damping will be determined from studies that account for the effect of generator amortisseur windings and the SSR filters.

6. Series Capacitor Switching

Series capacitors, locations to be determined from short circuit studies, will be flashed and reinserted as appropriate.

D. Short Circuit Studies

Three-phase and single-phase-to-ground faults will be evaluated.

1. Generation Representation

All generation will be represented.

2. Machine Reactance Representation

The saturated subtransient reactance (X''_d) values will be used.

3. Line Representation

The transmission line zero sequence impedance (X_0) is assumed to be equal to three times the positive sequence impedance (X_1).

4. Transformer Representation

The transformer zero sequence impedance (X_0) is assumed to be equal to the positive sequence impedance (X_1). Bulk substation transformers are modeled as auto-transformers. The two-winding model is that of a grounded-wye transformer. The three-winding model is that of a wye-delta-wye with a solid ground.

E. Reactive Power Margin Studies

Using Q-V curve analyses, APS assesses the interconnected transmission system to ensure there are sufficient reactive resources located throughout the electric system to maintain post-transient voltage stability for system normal conditions and certain contingencies.

IV. SYSTEM PERFORMANCE

A. Power Flow Studies

1. Normal (Base Case Conditions)

a. Voltage Levels

1) General

(a) 500kV bus voltages will be maintained between 1.05 and 1.08 p.u. on a 500kV base.

(b) 345kV bus voltages will range between .99 and 1.04 p.u. on the 345kV system.

(c) 500kV and 345kV system voltages are used to maintain proper 230kV bus voltages.

(d) Voltage on the 230kV and 115kV system should be between 1.01 p.u. and 1.05 p.u.

(e) Tap settings for 230/69kV and 345/69kV transformers should be used to maintain low side (69kV) voltages of 1.03 to 1.04 p.u. Seasonal tap changes may be required.

2) Specific Buses

(a) APS Pinnacle Peak 230kV bus voltage should be between 1.025 p.u. and 1.035 p.u.

(b) APS Westwing 230kV bus voltage should be between 1.04 p.u. and 1.05 p.u.

(c) Saguaro 115kV bus voltage will be approximately 1.035 p.u.

(d) Voltage at the Prescott (DOE) 230kV bus should be approximately 1.02 p.u.

b. Facility Loading Limits

1) Transmission Lines

Transmission line loading cannot exceed 100% of the continuous rating, which is based upon established conductor temperature limit or sag limitation.

2) Underground Cable

Underground cable loading should not exceed 100% of the continuous rating with all elements in service. This rating is based on a cable temperature of 85°C with no loss of cable life.

3) Transformers

Transformers cannot exceed 100% of top FOA, 65°C rise, nameplate ratings.

4) Series Capacitors

Series Capacitors cannot exceed 100% of continuous rating.

c. Interchange of VARs

Interchange of VARs between companies at interconnections will be reduced to a minimum and maintained near zero.

d. Distribution of Flow

Schedules on a new project will be compared to simulated power flows to ensure a reasonable level of flowability.

2. Single Contingency Outages

a. Voltage Levels

Maximum voltage deviation on APS' major buses cannot exceed 5%. This deviation level yields a close approximation to the post-transient VAR margin requirements of WECC.

b. Facilities Loading Limits

1) Transmission Lines

Transmission line loading cannot exceed 100% of the lesser of the sag limit or the emergency rating (30-minute rating) which is based upon established conductor temperature limits.

2) Underground Cable

Underground cable loading should not exceed the emergency rating during a single-contingency outage. This rating is based on a cable temperature of 105°C for two hours of emergency operation with no loss of cable life.

3) Transformers

Transformers cannot exceed 120% of top FOA, 65°C rise, nameplate ratings.

4) Series Capacitors

Series Capacitors cannot exceed 100% of emergency rating.

c. Generator Units

Generator units used for controlling remote voltages will be modified to hold their base case terminal voltages.

d. Impact on Interconnected System

Single contingency outages will not cause overloads upon any neighboring transmission system.

B. Transient Stability Studies

Transient stability studies are primarily performed on the 500kV and 345kV systems.

1. Fault Simulation

Three-phase-to-ground faults and single-line-to-ground faults, simulating a stuck circuit breaker in one phase with back-up delayed clearing will be simulated. Fault clearing times of four cycles after fault inception (5 cycles for a 230kV fault) and a back-up clearing time of twelve cycles after fault inception is utilized. System elements are switched out at the appropriate clearing times, as applicable. Fault damping will be applied when applicable at fault inception.

2. Series Capacitor Switching

Series capacitors, at locations determined from short-circuit studies, will be flashed at fault inception and will be reinserted depending on their reinsertion types.

3. System Stability

The system will be considered stable if the following conditions are met:

a. All machines in the system remain synchronized as demonstrated by the relative rotor angles.

b. Positive system damping exists as demonstrated by the damping of relative rotor angles and the damping of voltage magnitude swings. For N-1 disturbances, voltages for the first swing after fault clearing should not drop below 75% of pre-fault value with maximum time duration of 20 cycles for voltage dip exceeding 20%.

4. Re-closing

Automatic re-closing of circuit breakers controlling EHV facilities is not utilized.

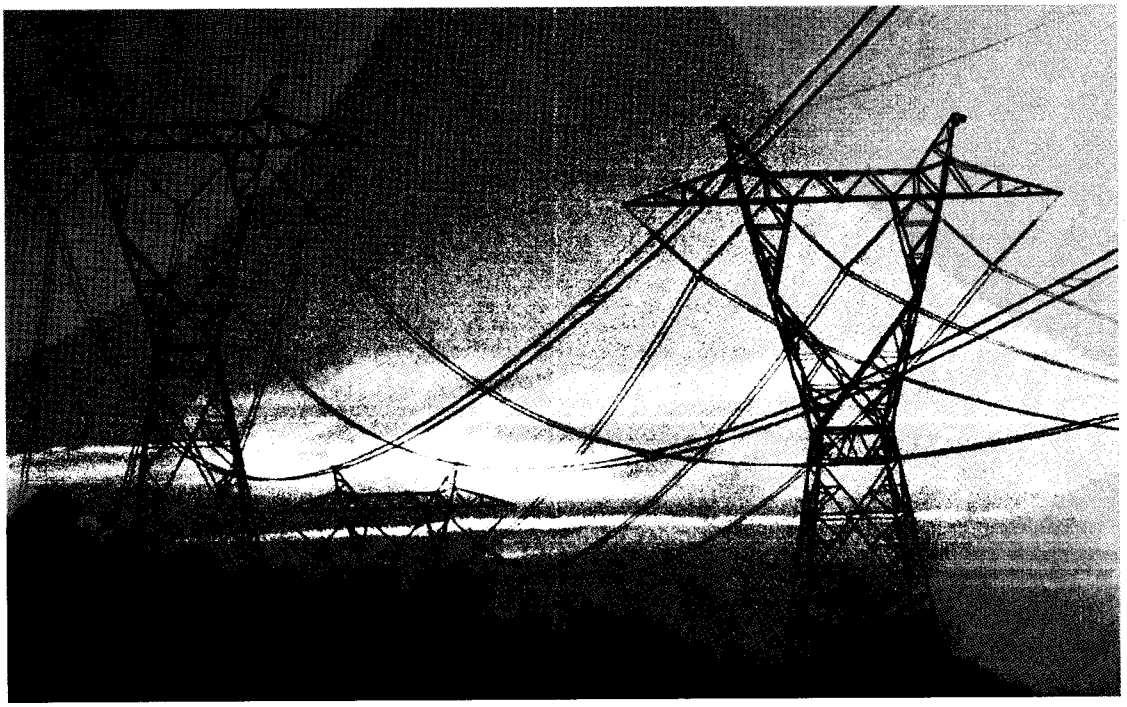
C. Short Circuit Studies

Fault current shall not exceed 100% of the applicable breaker fault current interruption capability for three-phase or single-line-to-ground faults.

D. Reactive Power Margin Studies

For system normal conditions or single contingency conditions, post-transient voltage stability is required with a path or load area modeled at a minimum of 105% of the path rating or maximum planned load limit for the area under study, whichever is applicable. For multiple contingencies, post-transient voltage stability is required with a path or load area modeled at a minimum of 102.5% of the path rating or maximum planned load limit for the area under study, whichever is applicable.

2008 SYSTEM RATING MAPS



PREPARED BY

TRANSMISSION OPERATIONS
July 2008

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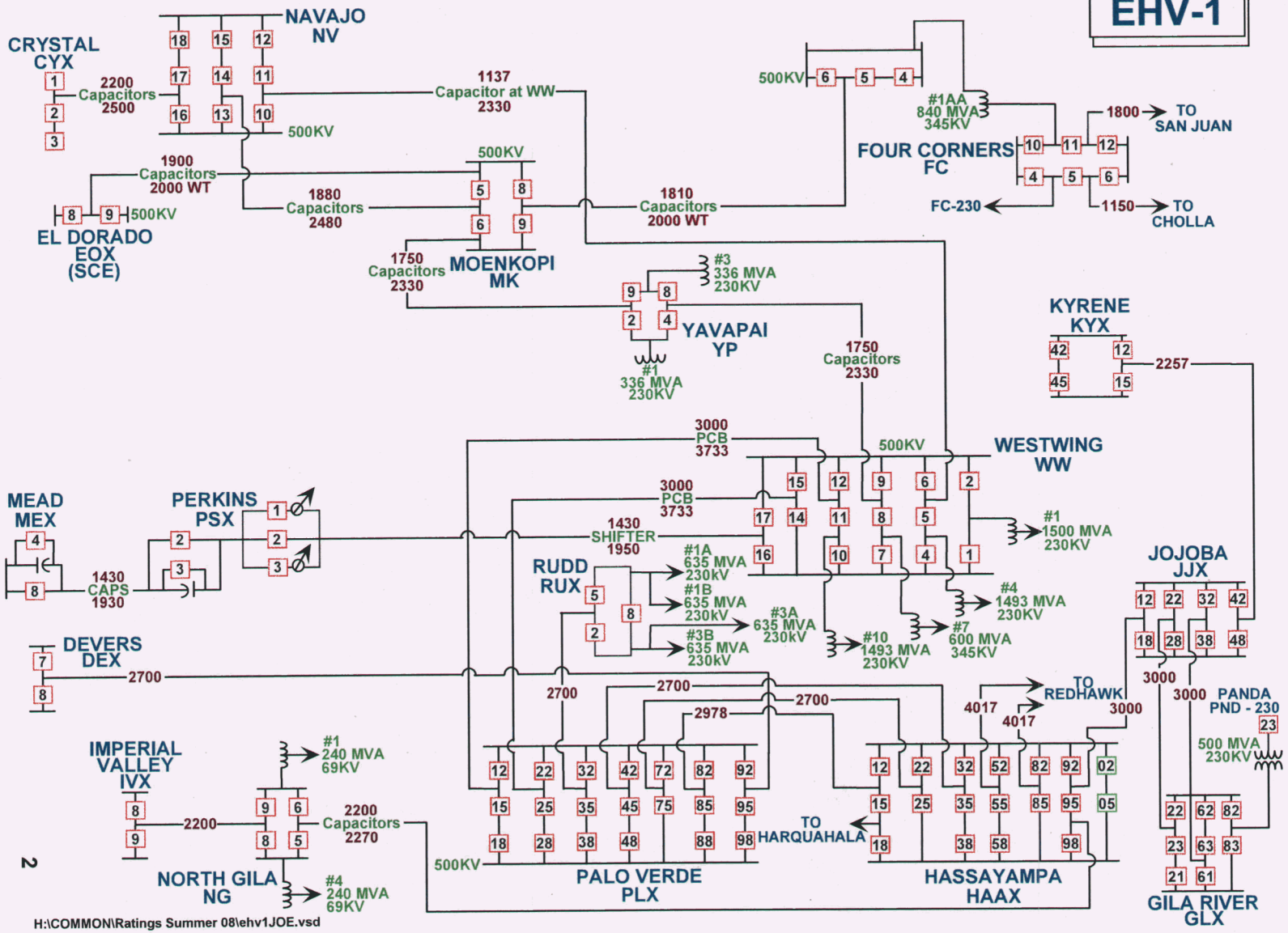
LEGEND
SYSTEM RATING MAPS

SYMBOL	DESCRIPTION
###	CURRENT LIMIT IN AMPS
—###	LIMITING ELEMENT
###	CONDUCTOR LIMIT IN AMPS
	TRANSFORMER LIMITS ARE IN MVA
———	OVERHEAD TRANSMISSION LINE
- - - - - -	UNDERGROUND CABLE
M	MOTOR OPERATED SWITCH
V	VACCUM SWITCH
H	HYDRAULIC SWITCH
1	BREAKER NUMBER

EHV-1



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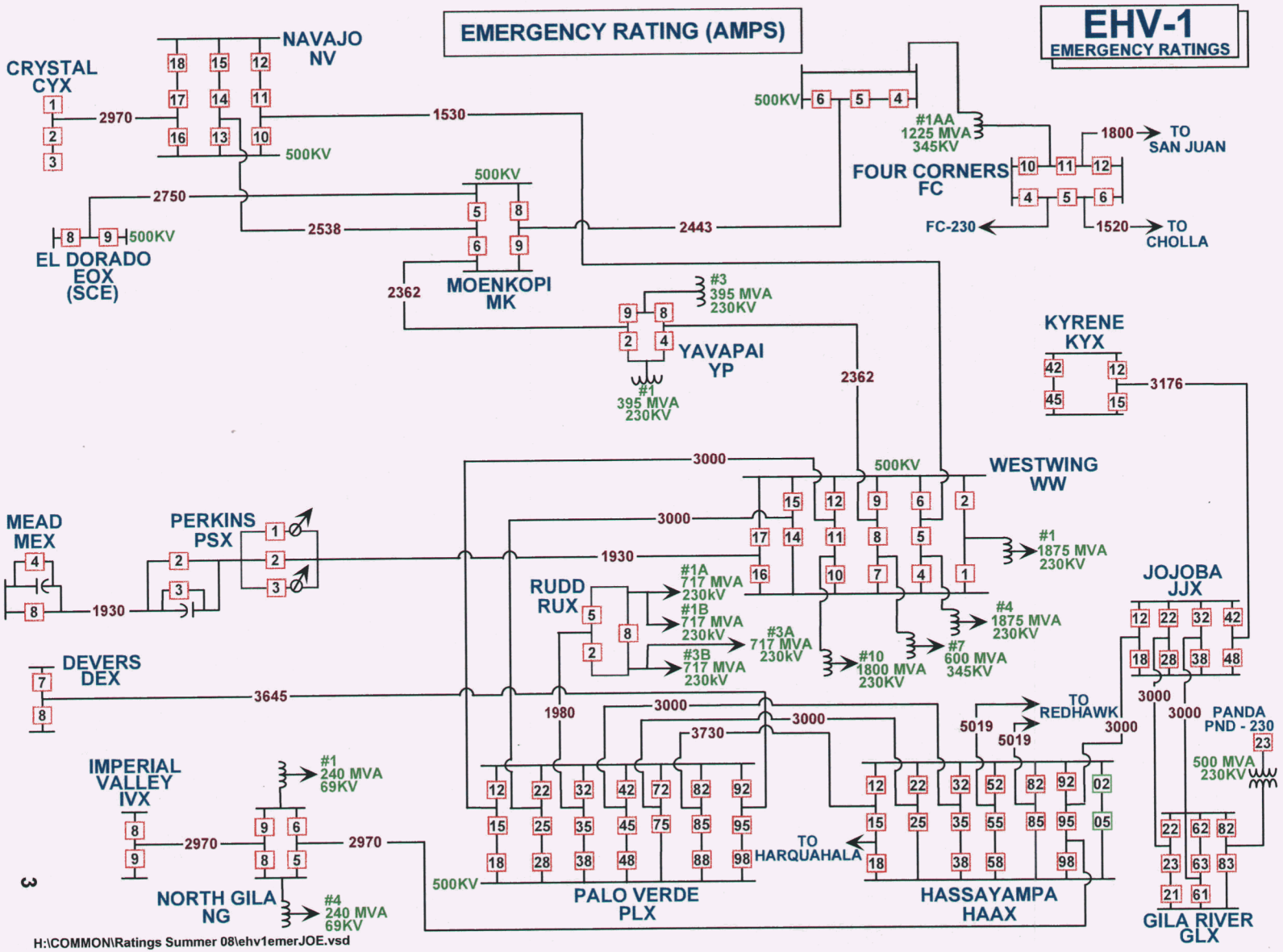

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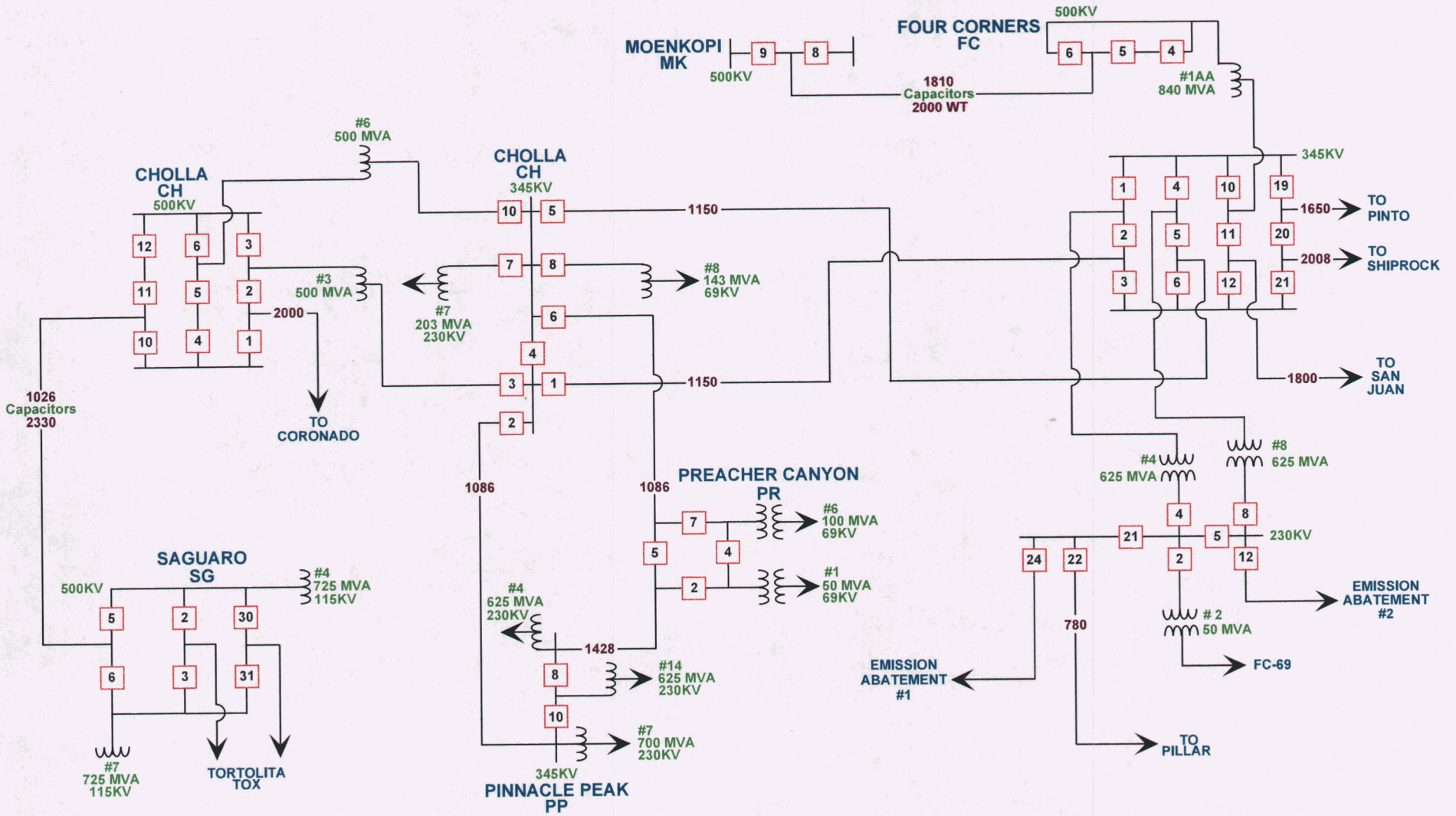
EHV-2



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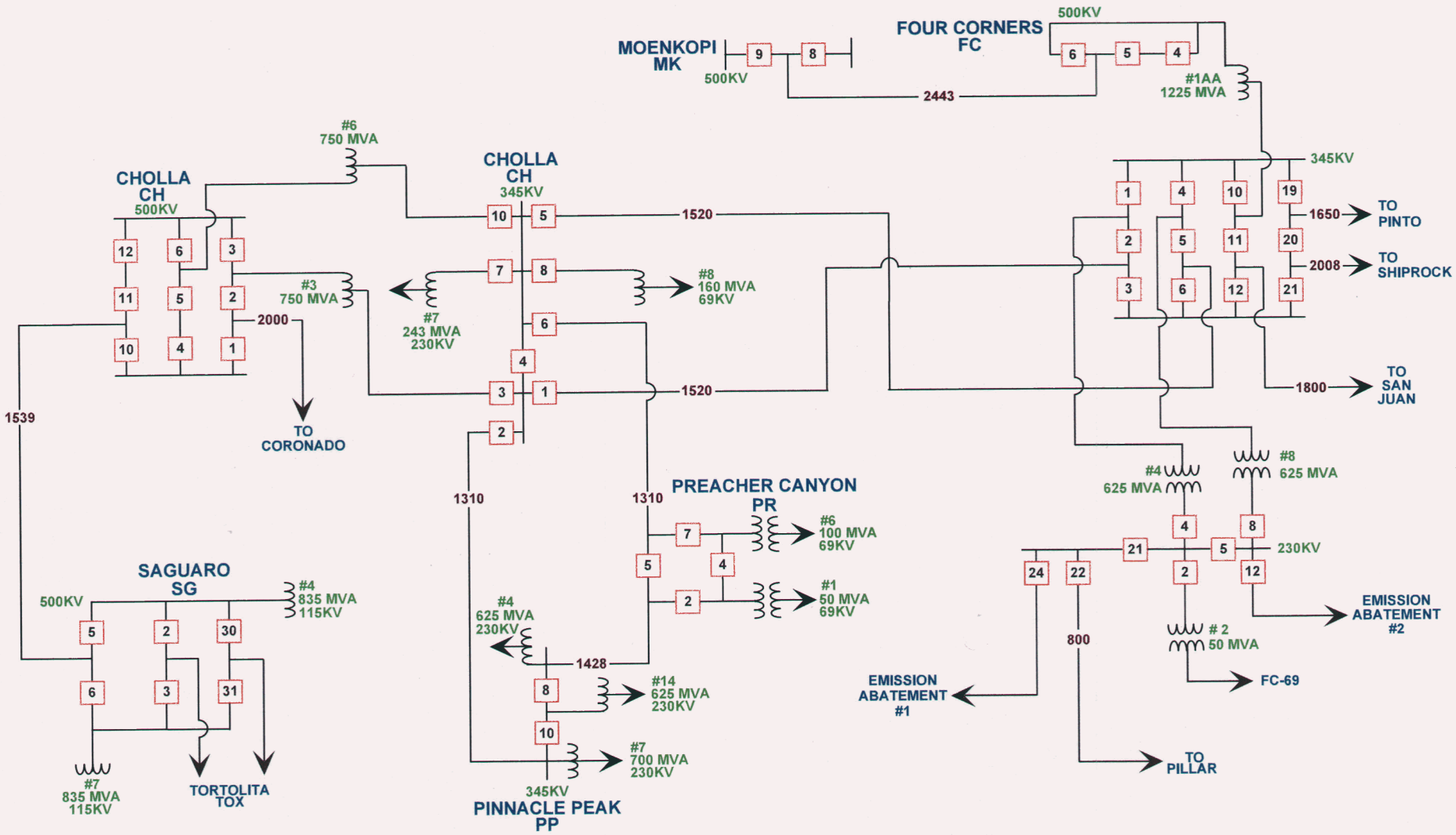
EHV-2
EMERGENCY RATINGS

EMERGENCY RATING (AMPS)



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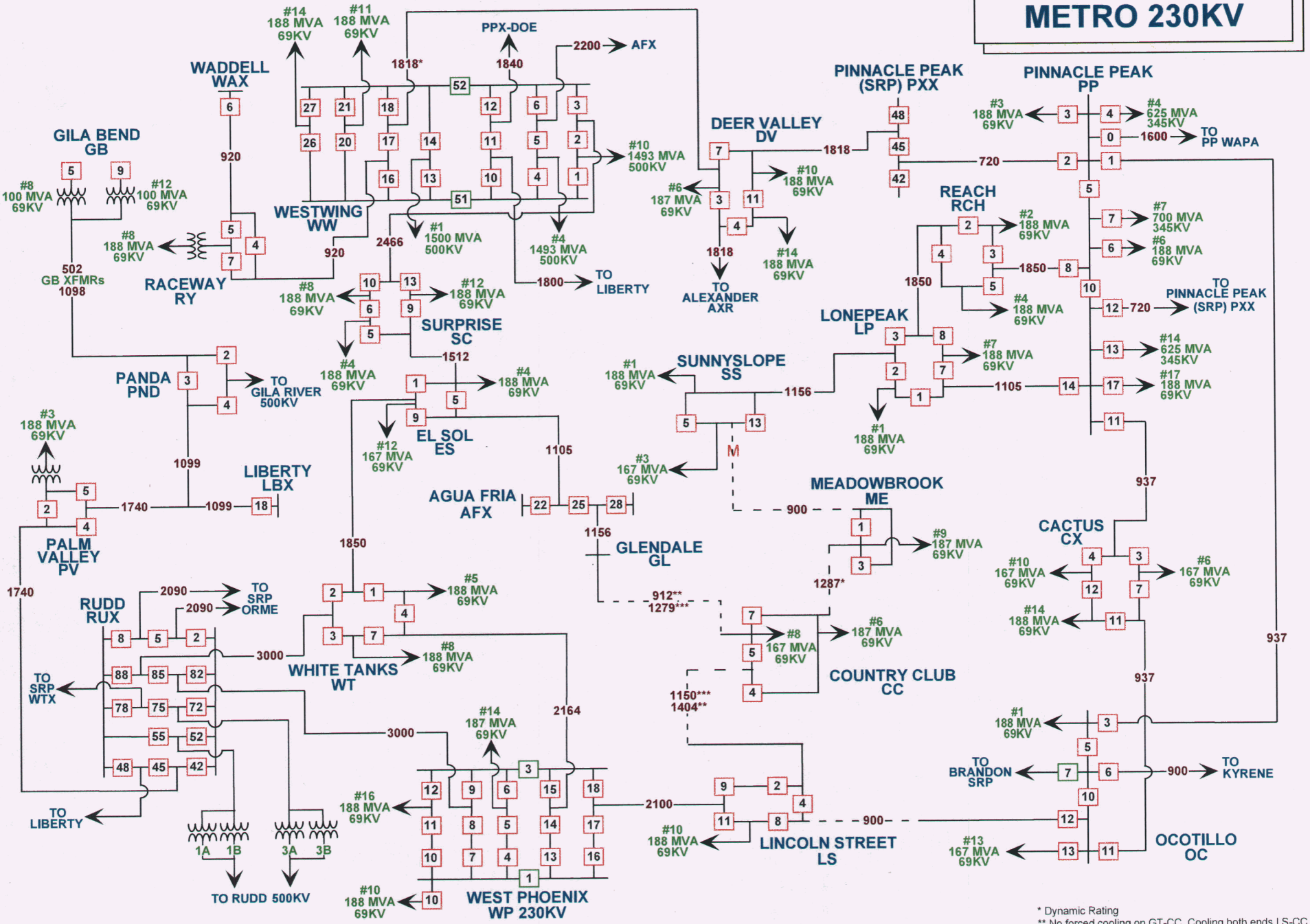
METRO 230KV



* Dynamic Rating
** No forced cooling on GT-CC, Cooling both ends LS-CC
*** Forced cooling on GT-CC, Cooling one end LS-CC

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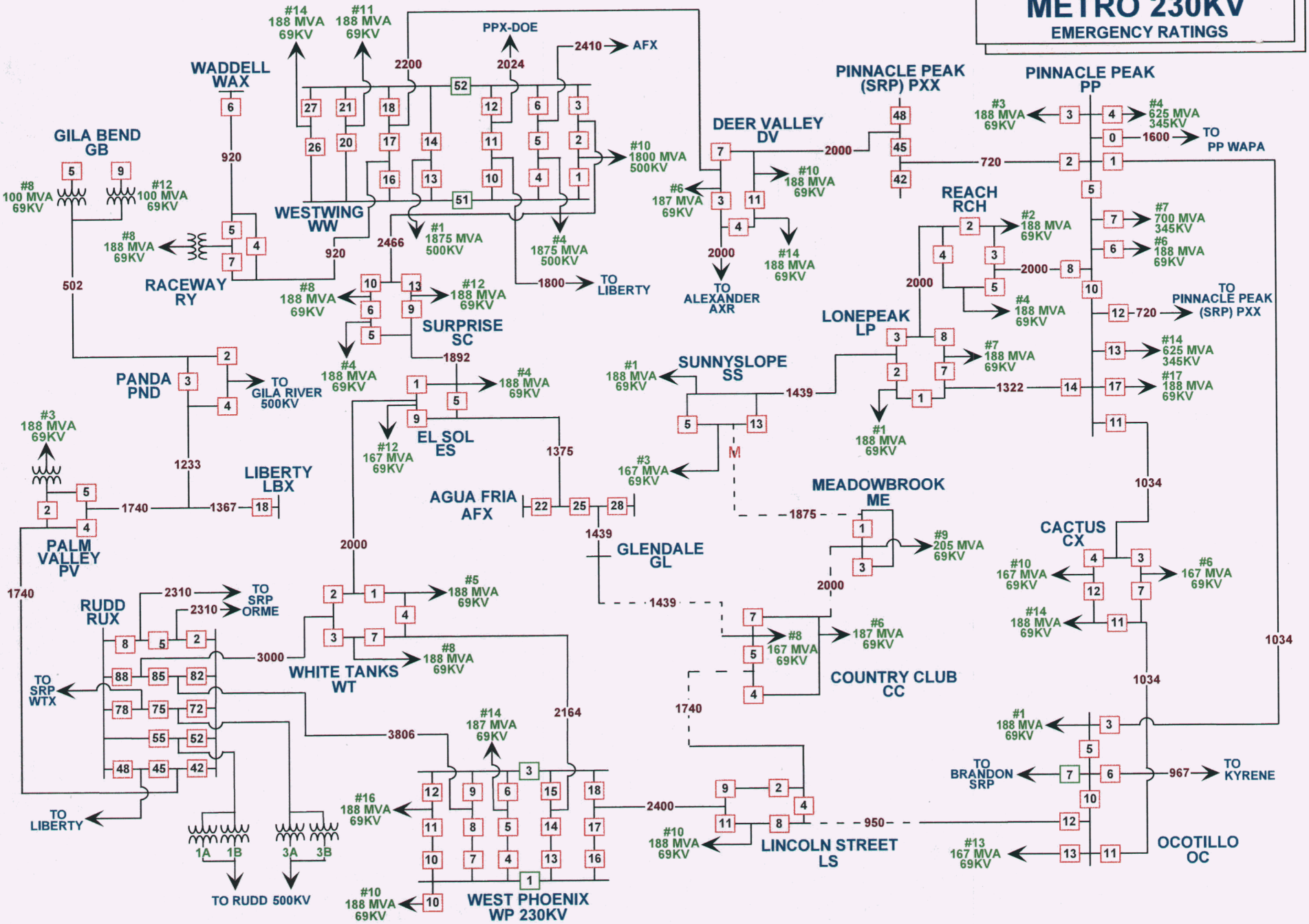
METRO 230KV
EMERGENCY RATINGS



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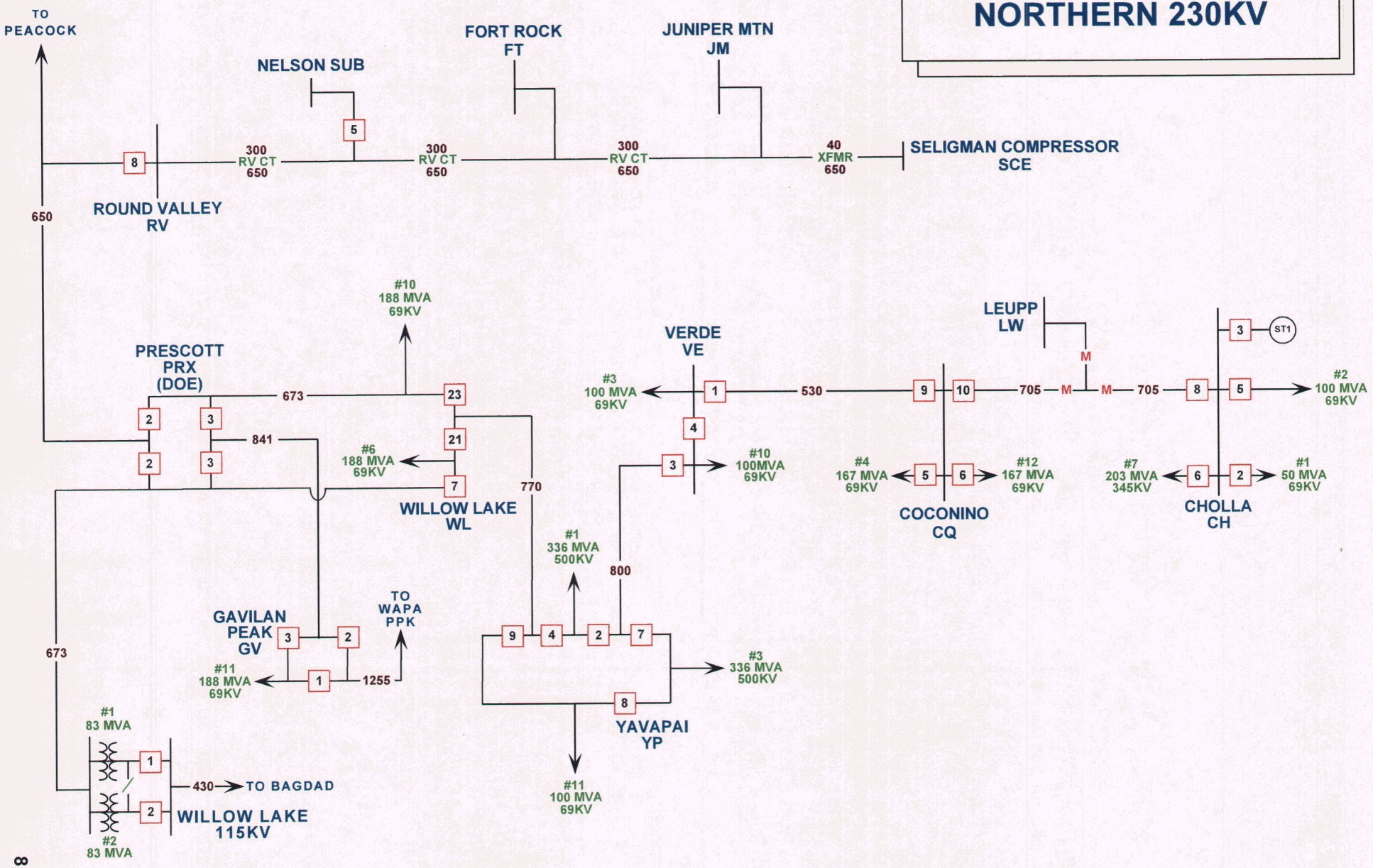
NORTHERN 230KV



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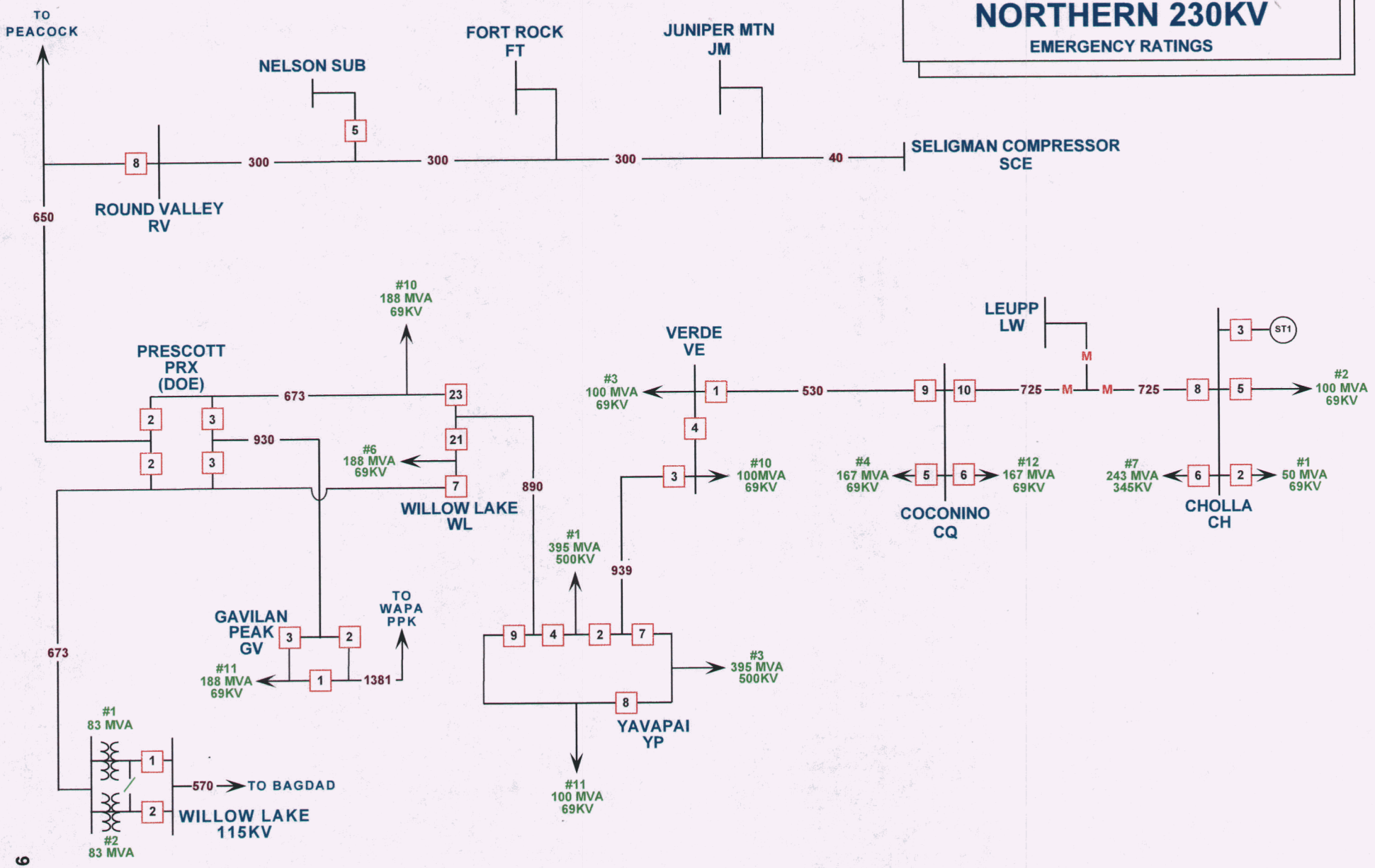
NORTHERN 230KV

EMERGENCY RATINGS



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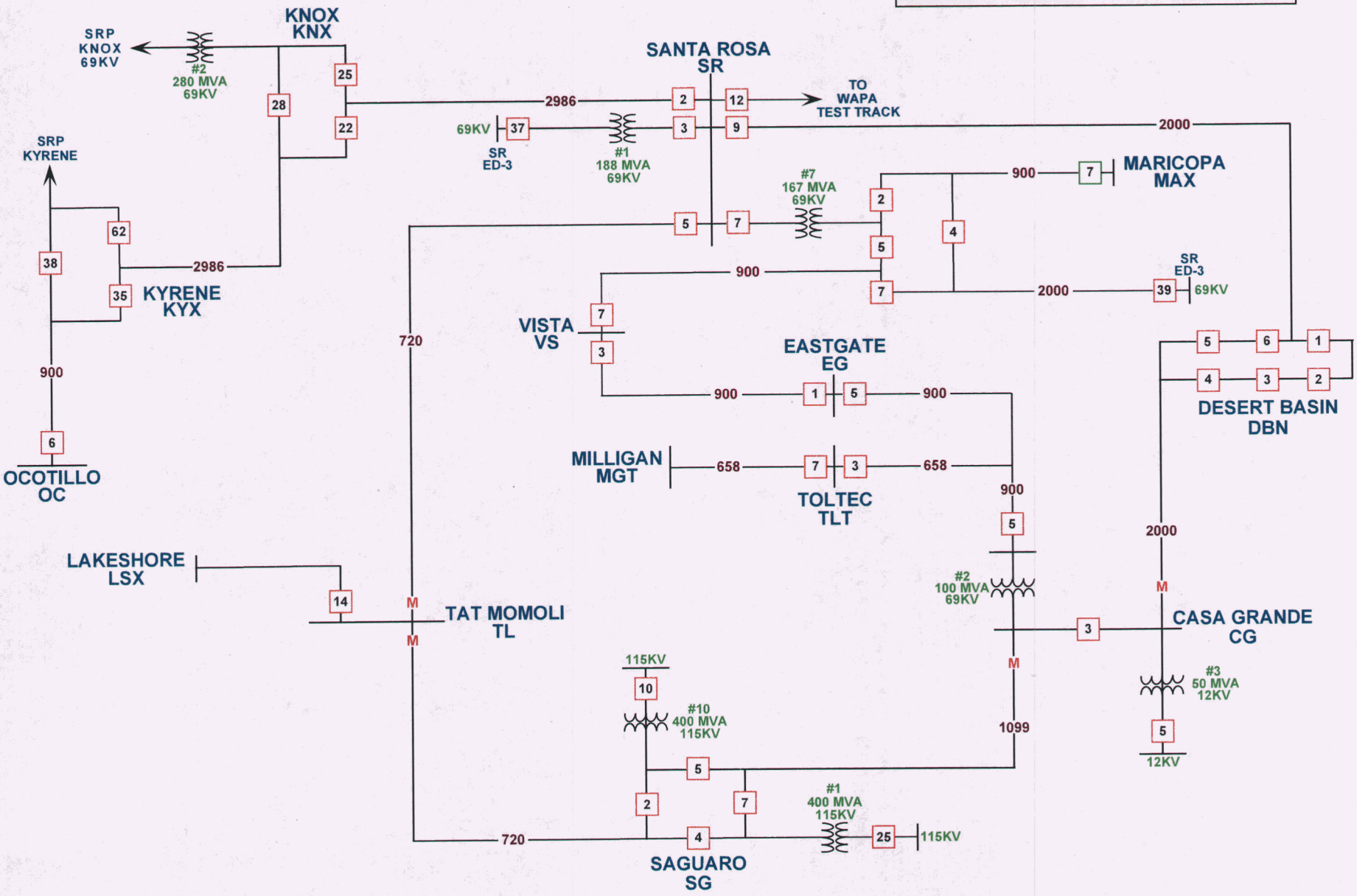
SOUTHERN 230KV



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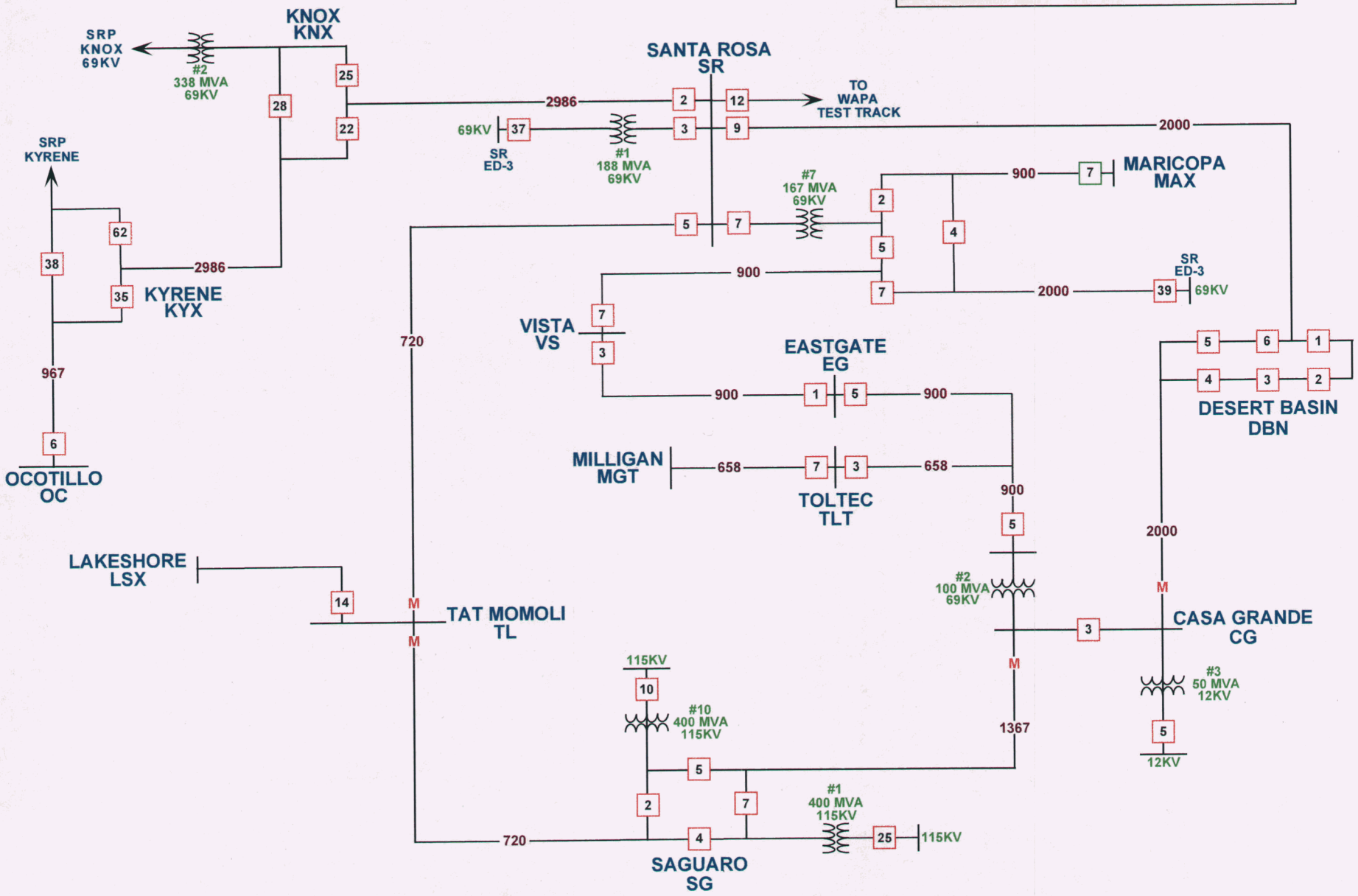
EMERGENCY RATINGS



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ARIZONA PUBLIC SERVICE COMPANY

TEN-YEAR PLAN

2009 – 2018

TECHNICAL STUDY REPORT

FOR

THE ARIZONA CORPORATION COMMISSION

JANUARY 2009

Executive Summary

Pursuant to NERC Standard TPL-001 "System Performance Under Normal (No Contingency) Conditions (Category A)", Arizona Public Service (APS) performs, on a yearly basis, a Category A analysis. The Category A analysis is performed for system conditions listed in Table I of the NERC/WECC Planning standards.

Results of the study indicate that, with the projects identified in APS's Ten-Year Transmission Plan, APS is fully compliant for WECC Standard TPL-001.

Pursuant to NERC Standard TPL-002 "System Performance Following Loss of a Single Bulk Electric System Element (Category B)", APS performs, on a yearly basis, a Category B contingency analysis. In Table I of the NERC/WECC planning standards, there are a total of four different Category B events that are to be studied each year to meet NERC Standard TPL-002.

A comprehensive list of contingencies was developed for the Category B contingency analysis and performed for the system conditions listed in Table I of the NERC/WECC Planning standards based on engineering judgment. APS believes that the selection of contingencies for inclusion in these studies, which is based on Category B of Table 1 of the NERC/WECC Planning standards, is acceptable to WECC. If requested by WECC, APS will implement measures to correct any deficiencies that have been identified by WECC.

Results of the study indicate that, with the projects identified in APS's Ten-Year Transmission Plan, APS is fully compliant for NERC Standard TPL-002.

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ARIZONA PUBLIC SERVICE COMPANY
2009-2018
TEN-YEAR PLAN
TECHNICAL STUDY REPORT

I. Introduction

This technical study report is filed annually with the Arizona Corporation Commission ("Commission") pursuant to ARS 40-360.02 and Commission Decision No. 63876 (July 25, 2001). This report summarizes the results of power flow analyses and stability analyses for the APS system.

Power flow analyses were conducted for every year within the ten year planning window (2009-2018) and performed for two scenarios: (i) assumption that all transmission system elements are in service and within continuous ratings (Category A); and (ii) assumption of an outage on a single element, with all remaining system elements remaining within emergency ratings (Category B). Voltage deviations for these scenarios must also be within established guidelines. These voltage deviation guidelines closely approximate post-transient VAR margin requirements of the Western Electricity Coordinating Council. More detail is provided in APS' Transmission Planning Process and Guidelines, which is also included in this filing.

The stability analyses were performed to simulate electrical disturbances on the transmission system and evaluate the system response. The desired result is that all generators will remain on line, no additional lines will open, and the system oscillations will damp out.

Results of the power flow and stability analyses aid in determining when and where new electrical facilities are needed because of reliability or security reasons. Additionally, some facilities are planned to address adequacy concerns. These include the interconnection of generation to the transmission system or efforts to increase import capability and/or export/scheduling capability to load-constrained or other areas.

II. Base Case Development

Power flow cases were created for each year of the 2009-2018 study time frame. These cases were developed from the latest available WECC heavy summer power flow cases. APS is a summer peaking system with the summer peak typically being approximately 40% higher than that of the winter peak. From a historical perspective, the summer peak is the most limiting for the APS system, and studies including other potential seasonal peaks are not warranted.

The 2008 Valley Operating case was chosen as the first seed case. This case was developed from a 2008 WECC Heavy Summer base case. The WECC case was then updated in a coordinated effort between APS and SRP to include the sub-transmission and distribution models and was the basis for the valley operating studies performed by APS and SRP for the 2008 summer operating season. This case was used as the seed

case in the creation of the 2009, 2010, 2011, and 2012 power flow cases used for the power flow analyses performed for the 2009-2018 Ten-Year plan. Each intermediate case developed was updated with the forecasted loads and any system additions/upgrades that are planned in the respective year.

The second seed case chosen was the 2013 Heavy Summer power flow case that was developed through the CATS-EHV sub-committee of SWAT. A recent WECC 2012 heavy summer power flow case was used as the initial case to develop the WestConnect 2013 heavy summer power flow case. In a collaborative effort, the Arizona utilities used the jointly developed 2013 WestConnect case to develop a 2013 summer case that included the sub-transmission and distribution systems of the Arizona utilities. This seed case was used to develop the 2014, 2015, and 2016 power flow cases. Each intermediate case developed was updated with the forecasted loads and any system additions/upgrades that are planned in the respective year.

The final seed case chosen was the WestConnect 2018 heavy summer power flow case. The latest WECC 2018 heavy summer power flow case was used as the initial case to develop the WestConnect 2018 heavy summer power flow case. In a collaborative effort, the Arizona utilities used the jointly developed 2018 WestConnect case to develop a 2018 summer case that included the sub-transmission and distribution systems of the Arizona utilities. This seed case was used to develop the 2017 power flow case. The 2017 case was updated with the forecasted load for 2017 and removed any system additions/upgrades that were planned for 2018.

These cases represent the latest transmission and sub-transmission plans, load projections, and resource plans of utilities and independent power producers. By utilizing WECC base cases, all loads, resources, power transfers, and planned projects within the WECC system are represented.

The APS system includes several reactive power resources that are used to maintain bus voltages within the limited defined by The Transmission Planning Process & Guidelines. These reactive power resources include shunt devices, series compensation, and tap changing transformers. The reactive power resources are adequate and meet the system performance.

III. Power Flow Analyses

Base case and single contingency conditions are evaluated to determine system needs and timing. Various iterations of possible solutions lead to the final plans for transmission additions. The contingency analysis involves simulations for every non-radial 115kV or above line that APS owns, partially owns, or operates. Transformer outages are also evaluated.

Existing protection system schemes are utilized in this study when necessary. The contingencies studied do not initially include the protection system schemes. However, if results indicate that an operation of a protection system is necessary, the contingency is studied again with the protection system modeled. There are no planned protection systems.

APS does not have any existing or planned control devices. These devices exist outside the APS control area; however, they are not utilized or their operation is not necessary as a result of the contingencies in this study.

All planned outages of bulk electric equipment at APS does not occur during the heavy summer peak time. Therefore it is not necessary to study planned outages since studies other than the summer peak scenario are not warranted.

Results of the power flow studies are tabulated in a Security Needs Table and an Adequacy Needs Table, below. These tables identify sixteen transmission projects that are included in this Ten-Year Plan filing. Some of the projects were classified as Adequacy Needs because of the uncertainty of generation location, size, and availability in the later years. As projects near the five-year planning time frame, they may be redefined as Security Needs projects. For the projects included in the Security Needs Table, selected maps of the power flow simulations are contained in Appendix B.

Table 1: Security Needs Table

Transmission Project	In Service Year	Critical Outage	Limiting Element	Map
Sugarloaf 500kV substation	2009	Cholla-Zeniff 69kV line	Voltage deviations and line overloads on the sub-transmission system in the area resulting in load shedding	B1-B2
Milligan loop-in of Saguaro-Casa Grande 230kV line	2009	Casa Grande 230/69kV transformer	Overloads Santa Rosa-Asarco 69kV line.	B3-B4
Dugas 500kV substation	2009	Verde-Cottonwood 69kV line	Voltage deviations and line overloads on the sub-transmission system in the area resulting in load shedding	B5-B6
Flagstaff 345/69kV interconnection	2012	230/69kV transformers at Coconino	Voltage deviations on the sub-transmission system in the area resulting in load shedding	B7-B8
TS6 230kV substation	2012	Adobe-Deer Valley 69kV line	Overloads Deer Valley-Rose Garden 69kV line	B9-B12
		Adobe-Stout 69kV line	Overloads Deer Valley-Rose Garden 69kV line	B13-B16
Mazatzal 345kV substation	2013	P1-Tonto 69kV line	Voltage deviations on the sub-transmission system in the area resulting in load shedding	B17-B18

Table 2: Adequacy Needs Table

Transmission Project	In Service Year	System Benefits
Loop-in of Navajo-Westwing 500kV into TS9 500kV substation and TS9-Pinnacle Peak 500kV line	2010	Increases import capability for the Phoenix Metropolitan area and export/scheduling capability from the PV area to provide access to both solar and gas resources. Increases transmission system reliability and ability to deliver power from these resources. Provides additional voltage support to the Phoenix Metropolitan 230kV and sub-transmission system.
Loop-in of Saguaro-Casa Grande 230kV line into TS12 230kV substation	2012	Provides a transmission source to serve the new load developing in the local area that does not have any electrical facilities existing in the area.
Desert Basin-Pinal South 230kV line and Pinal South-Sundance 230kV line	2013	Increases the reliability of the Sundance generating facility and provides an APS transmission path for delivery of the full output of the Sundance generating facility. Provides another transmission path in the regional system, thereby increasing the system reliability and capacity in order to continue to serve the growing electrical demand in an economical and reliable manner.
Palo Verde vicinity to North Gila 500kV.	2014	Increases import capability for the Yuma area and export/scheduling capability from the PV area to provide access to both solar and gas resources. Increases transmission system reliability and ability to deliver power from these resources. Increases transmission system reliability.
North Gila-TS8 230kV line.	2014	Increase transmission system reliability and ability to distribute and deliver power within the Yuma area.
Delany-Sun Valley 500kV line & Sun Valley-Trilby Wash 230kV line	2014	Increases the import capability for the Phoenix Metropolitan area and export/scheduling capability from the PV area to provide access to both solar and gas resources. Increases the system reliability by providing a new transmission source to help serve the growing areas in the western portions of the Phoenix Metropolitan area.
Palm Valley-TS2-Trilby Wash 230kV line	2015	Provides a second 230kV source for Trilby Wash so that it is not served as a radial substation, thereby increasing the local system reliability. Also, connecting the Sun Valley-Trilby Wash 230kV line to Palm Valley also increases the reliability of the high voltage transmission system on the western side of the Phoenix Metropolitan area.
Sun Valley-TS9 500kV line.	2016	Increases import capability for the Phoenix Metropolitan area and export/scheduling capability from the PV area which includes both solar and gas resources. Increases transmission system reliability and ability to deliver power from these resources. Provides a second 500kV source for the Sun Valley substation. Provides support for multiple Category C and D transmission contingencies.

IV. Stability Analyses

A stability simulation for simulated three-phase faults was performed for 2013 and 2018 for every non-radial 115kV, 230kV, 345kV or 500kV line that APS owns (totally or partially) or operates. It has been APS' experience that stability concerns do not manifest on the sub-transmission system, which is primarily designed to deliver power to load. Therefore, no simulations were performed at voltage levels less than 115kV, except at generator substation. Additionally, every new proposed generation plant will be required to perform stability evaluations prior to receiving permission to interconnect to the transmission system.

Each simulation modeled a 3-phase bus fault, appropriate series capacitor flashing and reinsertion, and fault removal and transmission line removal. System performance was evaluated by monitoring representative generator rotor angles, bus voltages and system frequency. Plots of these system parameters are included in Appendices C and D. The stability simulations performed to date indicate that no stability problems limit the transmission system.

V. Category A & B Contingency Study Results

A high level overview of the results for the Category A and Category B contingences is shown in Table 3. From this table, it is shown that each of the Category A and Category B contingencies meets the NERC/WECC Planning Standards.

Table 3: Overview of Category A & B Standard Results

		1-5 year Time Frame		6-10 year Time Frame	
	NERC Planning Standards Category A	Case Years Studied	Standards Met?	Case Years Studied	Standards Met?
1	All Facilities in Service	2009 through 2013	Yes	2014 through 2018	Yes
		1-5 year Time Frame		6-10 year Time Frame	
	NERC Planning Standards Category B	Case Years Studied	Standards Met?	Case Years Studied	Standards Met?
1	3-Phase Fault with Normal Clearing – Generator	2009 through 2013	Yes	2014 through 2018	Yes
2	3-Phase Fault with Normal Clearing – Transmission Circuit	2009 through 2013	Yes	2014 through 2018	Yes
3	3-Phase Fault with Normal Clearing – Transformer	2009 through 2013	Yes	2014 through 2018	Yes
4	Loss of an Element without a Fault	2009 through 2013	Yes	2014 through 2018	Yes

Table 3 is a high level summary that shows, with the projects listed in Tables 1 & 2, the APS system meets the criteria listed in NERC Standards TPL-001 and TPL-002. The transient stability plots are detailed in Appendices C & D. Due to the size of the power flow thermal and voltage steady state analysis the detailed results are not included. However, they are available upon request by WECC or any other authorized stakeholder.

APPENDIX A

Representative Contingency List

(2016 used as an example year)

2016 Single Contingency List (Category B)

Outage Number	Type	Contingency	Cirtcuit
line_1	"Line	CHOLLA 500.0 to SAGUARO 500.0	Circuit 1"
line_2	"Line	FOURCORN 500.0 to MOENKOPI 500.0	Circuit 1"
line_3	"Line	NAVAJO 500.0 to MOENKOPI 500.0	Circuit 1"
line_4	"Line	CHOLLA 345.0 to PNPKAPS 345.0	Circuit 1"
line_5	"Line	CHOLLA 345.0 to PRECHCYN 345.0	Circuit 1"
line_6	"Line	FOURCORN 345.0 to CHOLLA 345.0	Circuit 1"
line_7	"Line	FOURCORN 345.0 to CHOLLA 345.0	Circuit 2"
line_8	"Line	BUCKEYE 230.0 to LIBERTY 230.0	Circuit 1"
line_9	"Line	CACTUS 230.0 to OCOTILLO 230.0	Circuit 1"
line_10	"Line	CACTUS 230.0 to PPAPS N 230.0	Circuit 1"
line_11	"Line	CTRYCLUB 230.0 to LINCSTRT 230.0	Circuit 1"
line_12	"Line	CTRYCLUB 230.0 to GRNDTRML 230.0	Circuit 1"
line_13	"Line	DEERVALY 230.0 to ALEXANDR 230.0	Circuit 1"
line_14	"Line	DEERVALY 230.0 to PINPKSRP 230.0	Circuit 1"
line_15	"Line	EL SOL 230.0 to AGUAFRIA 230.0	Circuit 1"
line_16	"Line	GLENDALE 230.0 to GRNDTRML 230.0	Circuit 1"
line_17	"Line	GLENDALE 230.0 to AGUAFRIA 230.0	Circuit 1"
line_18	"Line	LEUPP 230.0 to COCONINO 230.0	Circuit 1"
line_19	"Line	LINCSTRT 230.0 to OCOTILLO 230.0	Circuit 1"
line_20	"Line	LINCSTRT 230.0 to WPHXAPSN 230.0	Circuit 1"
line_21	"Line	LONEPEAK 230.0 to PPAPS C 230.0	Circuit 1"
line_22	"Line	LONEPEAK 230.0 to SUNYSLOP 230.0	Circuit 1"
line_23	"Line	MEADOWBK 230.0 to CTRYCLUB 230.0	Circuit 1"
line_24	"Line	MEADOWBK 230.0 to SUNYSLOP 230.0	Circuit 1"
line_25	"Line	REACH 230.0 to LONEPEAK 230.0	Circuit 1"
line_26	"Line	REACH 230.0 to PNPKAPS 230.0	Circuit 1"
line_27	"Line	PPAPS N 230.0 to OCOTILLO 230.0	Circuit 1"
line_28	"Line	PPAPS N 230.0 to PINPKSRP 230.0	Circuit 1"
line_29	"Line	PPAPS N 230.0 to PINPKSRP 230.0	Circuit 2"
line_30	"Line	PNPKAPS 230.0 to PINPK 230.0	Circuit 1"
line_31	"Line	SAGUARO 230.0 to TATMOMLI 230.0	Circuit 1"
line_32	"Line	SNTAROSA 230.0 to TATMOMLI 230.0	Circuit 1"
line_33	"Line	SNTAROSA 230.0 to TESTTRAK 230.0	Circuit 1"
line_34	"Line	SURPRISE 230.0 to EL SOL 230.0	Circuit 1"
line_35	"Line	SURPRISE 230.0 to WESTWNGW 230.0	Circuit 1"
line_36	"Line	WESTWNGW 230.0 to PINPK 230.0	Circuit 1"
line_37	"Line	WHTNKAPS 230.0 to EL SOL 230.0	Circuit 1"
line_38	"Line	WHTNKAPS 230.0 to RUDD 230.0	Circuit 1"
line_39	"Line	WPHXAPSS 230.0 to WPHXAPSN 230.0	Circuit 1"
line_40	"Line	PNPKAPS 230.0 to PPAPS C 230.0	Circuit 1"
line_41	"Line	PPAPS C 230.0 to PPAPS N 230.0	Circuit 1"
line_42	"Line	WPHXAPSS 230.0 to RUDD 230.0	Circuit 1"
line_43	"Line	YAVAPAI 230.0 to VERDE N 230.0	Circuit 1"
line_44	"Line	YAVAPAI 230.0 to WILOWLKE 230.0	Circuit 1"
line_45	"Line	KYR-NEW 230.0 to OCOTILLO 230.0	Circuit 1"
line_46	"Line	KYR-NEW 230.0 to KNOX 230.0	Circuit 1"

line_47	"Line	PANDA 230.0 to GILABEND 230.0	Circuit 1"
line_48	"Line	WPHXAPSN 230.0 to WHTNKAPS 230.0	Circuit 1"
line_49	"Line	FORTROCK 230.0 to RNDVLYAZ 230.0	Circuit 1"
line_50	"Line	FORTROCK 230.0 to JUNIPRMT 230.0	Circuit 1"
line_51	"Line	ALEXNDR 230.0 to ALEXANDR 230.0	Circuit 1"
line_52	"Line	WILOWLKW 230.0 to PRESCOTT 230.0	Circuit 1"
line_53	"Line	WILOWLKW 230.0 to WILOWLKE 230.0	Circuit 1"
line_54	"Line	JUNIPRMT 230.0 to SELIGMAN 230.0	Circuit 1"
line_55	"Line	CORONADO 500.0 to SILVERKG 500.0	Circuit 1"
line_56	"Line	PALOVRDE 500.0 to WESTWING 500.0	Circuit 1"
line_57	"Line	PALOVRDE 500.0 to WESTWING 500.0	Circuit 2"
line_58	"Line	PALOVRDE 500.0 to RUDD 500.0	Circuit 1"
line_59	"Line	PERK PS1 500.0 to PERKINPS 500.0	Circuit 1"
line_60	"Line	PERK PS2 500.0 to PERKINPS 500.0	Circuit 1"
line_61	"Line	SILVERKG 500.0 to BROWNING 500.0	Circuit 1"
line_62	"Line	BROWNING 500.0 to KYRENE 500.0	Circuit 1"
line_63	"Line	HASSYAMP 500.0 to REDHAWK 500.0	Circuit 1"
line_64	"Line	HASSYAMP 500.0 to REDHAWK 500.0	Circuit 2"
line_65	"Line	HASSYAMP 500.0 to PALOVRDE 500.0	Circuit 1"
line_66	"Line	HASSYAMP 500.0 to PALOVRDE 500.0	Circuit 2"
line_67	"Line	HASSYAMP 500.0 to PALOVRDE 500.0	Circuit 3"
line_68	"Line	HASSYAMP 500.0 to PINAL_W 500.0	Circuit 1"
line_69	"Line	HASSYAMP 500.0 to ARLINTON 500.0	Circuit 1"
line_70	"Line	HASSYAMP 500.0 to MESQUITE 500.0	Circuit 1"
line_71	"Line	AGUAFRIA 230.0 to WESTWNGW 230.0	Circuit 1"
line_72	"Line	AGUAFRIA 230.0 to ALEXANDR 230.0	Circuit 1"
line_73	"Line	AGUAFRIA 230.0 to WHITETNK 230.0	Circuit 1"
line_74	"Line	ANDERSON 230.0 to ORME 230.0	Circuit 1"
line_75	"Line	BRANDOW 230.0 to KYRENE 230.0	Circuit 1"
line_76	"Line	BRANDOW 230.0 to PAPAGOBT 230.0	Circuit 1"
line_77	"Line	BRANDOW 230.0 to WARD 230.0	Circuit 1"
line_78	"Line	BRANDOW 230.0 to WARD 230.0	Circuit 2"
line_79	"Line	CORBELL 230.0 to KYRENE 230.0	Circuit 1"
line_80	"Line	KYRENE 230.0 to KYR-NEW 230.0	Circuit 1"
line_81	"Line	KYRENE 230.0 to SCHRADER 230.0	Circuit 1"
line_82	"Line	ORME 230.0 to RUDD 230.0	Circuit 1"
line_83	"Line	PAPAGOBT 230.0 to PINPKSRP 230.0	Circuit 1"
line_84	"Line	BRANDOW 230.0 to PINPKSRP 230.0	Circuit 1"
line_85	"Line	BRANDOW 230.0 to PINPKSRP 230.0	Circuit 2"
line_86	"Line	ROGERS 230.0 to THUNDRST 230.0	Circuit 1"
line_87	"Line	ROGERS 230.0 to ROGSWAPA 230.0	Circuit 1"
line_88	"Line	ROGERS 230.0 to ROGSWAPA 230.0	Circuit 2"
line_89	"Line	SANTAN 230.0 to CORBELL 230.0	Circuit 1"
line_90	"Line	SANTAN 230.0 to THUNDRST 230.0	Circuit 1"
line_91	"Line	SCHRADER 230.0 to SANTAN 230.0	Circuit 1"
line_92	"Line	THUNDRST 230.0 to GOLDFELD 230.0	Circuit 1"
line_93	"Line	THUNDRST 230.0 to GOLDFELD 230.0	Circuit 2"
line_94	"Line	KNOX 230.0 to SNTAROSA 230.0	Circuit 1"
line_95	"Line	BROWNING 230.0 to SANTAN 230.0	Circuit 1"
line_96	"Line	RUDD 230.0 to WHITETNK 230.0	Circuit 1"

line_97	"Line	RUDD 230.0 to LIBERTY 230.0	Circuit 1"
line_98	"Line	COPPERVR 230.0 to FRISCO 230.0	Circuit 1"
line_99	"Line	APACHE 230.0 to BUTERFLD 230.0	Circuit 1"
line_100	"Line	APACHE 230.0 to RED TAIL 230.0	Circuit 1"
line_101	"Line	APACHE 230.0 to WINCHSTR 230.0	Circuit 1"
line_102	"Line	BUTERFLD 230.0 to SAN RAF 230.0	Circuit 1"
line_103	"Line	MORENCI 230.0 to GREEN-AE 230.0	Circuit 1"
line_104	"Line	RED TAIL 230.0 to DOSCONDO 230.0	Circuit 1"
line_105	"Line	SAHUARIT 230.0 to BICKNELL 230.0	Circuit 1"
line_106	"Line	MEAD N 230.0 to HVRA3A4 230.0	Circuit 1"
line_107	"Line	MEAD S 230.0 to MEAD N 230.0	Circuit 1"
line_108	"Line	DAVIS 230.0 to RIVIERA 230.0	Circuit 1"
line_109	"Line	DAVIS 230.0 to MEAD N 230.0	Circuit 1"
line_110	"Line	DAVIS 230.0 to TOPOCK 230.0	Circuit 2"
line_111	"Line	HOVRA5A6 230.0 to MEAD S 230.0	Circuit 1"
line_112	"Line	HOVRA7-9 230.0 to MEAD S 230.0	Circuit 1"
line_113	"Line	MEAD 500.0 to PERKINS 500.0	Circuit 1"
line_114	"Line	PARKER 230.0 to EAGLEYE 230.0	Circuit 1"
line_115	"Line	PARKER 230.0 to BLK MESA 230.0	Circuit 1"
line_116	"Line	PARKER 230.0 to HAVASU 230.0	Circuit 1"
line_117	"Line	PARKER 230.0 to HARCUVAR 230.0	Circuit 1"
line_118	"Line	COOLIDGE 230.0 to SUN ARIZ 230.0	Circuit 1"
line_119	"Line	COOLIDGE 230.0 to SUN ARIZ 230.0	Circuit 2"
line_120	"Line	LIBERTY 230.0 to WESTWNGW 230.0	Circuit 1"
line_121	"Line	LIBERTY 230.0 to LONE BUT 230.0	Circuit 1"
line_122	"Line	LIBERTY 230.0 to PHXWAPA 230.0	Circuit 1"
line_123	"Line	LIBERTY 345.0 to PEACOCK 345.0	Circuit 1"
line_124	"Line	LONE BUT 230.0 to TESTTRAK 230.0	Circuit 1"
line_125	"Line	LONE BUT 230.0 to SUN ARIZ 230.0	Circuit 1"
line_126	"Line	MCCONICO 230.0 to DAVIS 230.0	Circuit 1"
line_127	"Line	MCCONICO 230.0 to GRIFFITH 230.0	Circuit 1"
line_128	"Line	MCCONICO 230.0 to HARRIS 230.0	Circuit 1"
line_129	"Line	PHXWAPA 230.0 to LONE BUT 230.0	Circuit 1"
line_130	"Line	PINPK 230.0 to PINPKSRP 230.0	Circuit 1"
line_131	"Line	PINPK 230.0 to PINPKSRP 230.0	Circuit 2"
line_132	"Line	TESTTRAK 230.0 to CASAGRND 230.0	Circuit 1"
line_133	"Line	HILLTOP 230.0 to MCCONICO 230.0	Circuit 1"
line_134	"Line	N.HAVASU 230.0 to PARKER 230.0	Circuit 1"
line_135	"Line	N.HAVASU 230.0 to TOPOCK 230.0	Circuit 1"
line_136	"Line	HOVRN7N8 230.0 to MEAD S 230.0	Circuit 1"
line_137	"Line	HOVRN5N6 230.0 to MEAD S 230.0	Circuit 1"
line_138	"Line	HOVRN3N4 230.0 to MEAD S 230.0	Circuit 1"
line_139	"Line	HOVRN1N2 230.0 to MEAD S 230.0	Circuit 1"
line_140	"Line	HOVRA1A2 230.0 to MEAD S 230.0	Circuit 1"
line_141	"Line	HARCUVAR 230.0 to HARCU AZ 230.0	Circuit 1"
line_142	"Line	HARCUVAR 230.0 to HASSYTAP 230.0	Circuit 1"
line_143	"Line	SPKHILTP 230.0 to COOLIDGE 230.0	Circuit 1"
line_144	"Line	GRIFFITH 230.0 to PEACOCK 230.0	Circuit 1"
line_145	"Line	PEACOCK 230.0 to HILLTOP 230.0	Circuit 1"
line_146	"Line	PEACOCK 345.0 to MEAD 345.0	Circuit 1"

line_147	"Line	TOPOCK 230.0 to BLK MESA 230.0	Circuit 1"
line_148	"Line	TOPOCK 230.0 to SOPOINT 230.0	Circuit 1"
line_149	"Line	TOPOCK 230.0 to SOPOINT 230.0	Circuit 2"
line_150	"Line	HASSYTAP 230.0 to HASSY AZ 230.0	Circuit 1"
line_151	"Line	HASSYTAP 230.0 to LIBERTY 230.0	Circuit 1"
line_152	"Line	RNDVLYTP 230.0 to RNDVLYAZ 230.0	Circuit 1"
line_153	"Line	RNDVLYTP 230.0 to PEACOCK 230.0	Circuit 1"
line_154	"Line	ROGSWAPA 230.0 to PINPK 230.0	Circuit 1"
line_155	"Line	ROGSWAPA 230.0 to PINPK 230.0	Circuit 2"
line_156	"Line	ROGSWAPA 230.0 to SPKHILTP 230.0	Circuit 1"
line_157	"Line	FLAGSTAF 345.0 to GLENCANY 345.0	Circuit 1"
line_158	"Line	FLAGSTAF 345.0 to GLENCANY 345.0	Circuit 2"
line_159	"Line	FLAGSTAF 345.0 to PINPKBRB 345.0	Circuit 1"
line_160	"Line	FLAGSTAF 345.0 to PINPKBRB 345.0	Circuit 2"
line_161	"Line	GLEN PS 230.0 to NAVAJO 230.0	Circuit 1"
line_162	"Line	KAYENTA 230.0 to SHIPROCK 230.0	Circuit 1"
line_163	"Line	KAYENTA 230.0 to LNGHOUSE 230.0	Circuit 1"
line_164	"Line	SHIPROCK 345.0 to FOURCORN 345.0	Circuit 1"
line_165	"Line	NAVAJO 230.0 to LNGHOUSE 230.0	Circuit 1"
line_166	"Line	TS4 230.0 to PALMVLY 230.0	Circuit 1"
line_167	"Line	RUDD 230.0 to PALMVLY 230.0	Circuit 1"
line_168	"Line	LIBERTY 230.0 to TS4 230.0	Circuit 1"
line_169	"Line	DINOSAUR 230.0 to BROWNING 230.0	Circuit 1"
line_170	"Line	BUTERFLD 230.0 to SLOAN 0.0	Circuit 1"
line_171	"Line	DOSCONDO 230.0 to HACKBERY 230.0	Circuit 1"
line_172	"Line	HACKBERY 230.0 to MORENCI 230.0	Circuit 1"
line_173	"Line	ABEL 500.0 to PINAL_C 500.0	Circuit 1"
line_174	"Line	ANDERSON 230.0 to ORME 230.0	Circuit 2"
line_175	"Line	ORME 230.0 to RUDD 230.0	Circuit 2"
line_176	"Line	ABEL 500.0 to BROWNING 500.0	Circuit 1"
line_177	"Line	DAVIS 230.0 to ZORB 230.0	Circuit 1"
line_178	"Line	ZORB 230.0 to TOPOCK 230.0	Circuit 1"
line_179	"Line	FOURCORN 500.0 to FCW 500.0	Circuit 1"
line_180	"Line	MOENKOPI 500.0 to RME 500.0	Circuit 1"
line_181	"Line	NAVAJO 500.0 to RME 500.0	Circuit 1"
line_182	"Line	DRPP 500.0 to FCW 500.0	Circuit 1"
line_183	"Line	DRPP 500.0 to FCW 500.0	Circuit 2"
line_184	"Line	RME 500.0 to FCW 500.0	Circuit 1"
line_185	"Line	NAVAJO 500.0 to DUGAS 500.0	Circuit 1"
line_186	"Line	RACEWAY 500.0 to WESTWING 500.0	Circuit 1"
line_187	"Line	RACEWAY 500.0 to PNPKAPS 500.0	Circuit 1"
line_188	"Line	SGRLF 500.0 to CHOLLA 500.0	Circuit 1"
line_189	"Line	DUGAS 500.0 to RACEWAY 500.0	Circuit 1"
line_190	"Line	AVERY 230.0 to RACEWAY 230.0	Circuit 1"
line_191	"Line	AVERY 230.0 to TS6 230.0	Circuit 1"
line_192	"Line	TS6 230.0 to PNPKAPS 230.0	Circuit 1"
line_193	"Line	SNVLY 230.0 to TRLBY 230.0	Circuit 1"
line_194	"Line	SNVLY 230.0 to TRLBY 230.0	Circuit 2"
line_195	"Line	CORONADO 500.0 to SGRLF 500.0	Circuit 1"
line_196	"Line	PERKINS 500.0 to WESTWING 500.0	Circuit 1"

line_197	"Line	PD-MORNC 230.0 to FRISCO 230.0	Circuit 1"
line_198	"Line	CHOLLA 230.0 to LEUPP 230.0	Circuit 1"
line_199	"Line	SNVLY 230.0 to HASSY AZ 230.0	Circuit 1"
line_200	"Line	CASGRAPS 230.0 to DBG 230.0	Circuit 1"
line_201	"Line	SNTAROSA 230.0 to DBG 230.0	Circuit 1"
line_202	"Line	MEAD S 230.0 to EQUEST 230.0	Circuit 1"
line_203	"Line	MEAD N 230.0 to EQUEST 230.0	Circuit 2"
line_204	"Line	MEAD N 230.0 to NEWPORT 230.0	Circuit 1"
line_205	"Line	MEAD N 230.0 to EASTSIDE 230.0	Circuit 1"
line_206	"Line	MOENKOPI 500.0 to MARKETPL 500.0	Circuit 1"
line_207	"Line	NAVAJO 500.0 to CRYSTAL 500.0	Circuit 1"
line_208	"Line	FOURCORN 345.0 to RIOPUERC 345.0	Circuit 1"
line_209	"Line	FOURCORN 345.0 to SAN_JUAN 345.0	Circuit 1"
line_210	"Line	FOURCORN 345.0 to WESTMESA 345.0	Circuit 1"
line_211	"Line	FOURCORN 230.0 to PILLAR 230.0	Circuit 1"
line_212	"Line	HENDRSON 230.0 to MEAD N 230.0	Circuit 1"
line_213	"Line	H ALLEN 500.0 to MEAD 500.0	Circuit 1"
line_214	"Line	BC TAP 230.0 to MEAD N 230.0	Circuit 1"
line_215	"Line	DAVIS 230.0 to MCCULLGH 230.0	Circuit 1"
line_216	"Line	MEAD N 230.0 to DECATUR 230.0	Circuit 1"
line_217	"Line	MEAD S 230.0 to PAHRUMP 230.0	Circuit 1"
line_218	"Line	MEAD S 230.0 to GREENWAY 230.0	Circuit 1"
line_219	"Line	MEAD S 230.0 to MCCULLGH 230.0	Circuit 1"
line_220	"Line	MEAD S 230.0 to MCCULLGH 230.0	Circuit 2"
line_221	"Line	MEAD 500.0 to MARKETPL 500.0	Circuit 1"
line_222	"Line	PINTO PS 345.0 to FOURCORN 345.0	Circuit 1"
line_223	"Line	SIGURDPS 230.0 to GLENCANY 230.0	Circuit 1"
line_224	"Line	SHIPROCK 345.0 to SAN_JUAN 345.0	Circuit 1"
line_225	"Line	HASSYAMP 500.0 to N.GILA 500.0	Circuit 1"
line_226	"Line	MOENKOPI 500.0 to ELDORDO 500.0	Circuit 1"
line_227	"Line	PALOVRDE 500.0 to DEVERS 500.0	Circuit 1"
line_228	"Line	MEAD S 230.0 to ELDORDO 230.0	Circuit 1"
line_229	"Line	MEAD S 230.0 to ELDORDO 230.0	Circuit 2"
line_230	"Line	PARKER 230.0 to GENE 230.0	Circuit 1"
line_231	"Line	CAMINO 230.0 to MEAD S 230.0	Circuit E"
line_232	"Line	CAMINO 230.0 to MEAD S 230.0	Circuit W"
line_233	"Line	MEAD N 230.0 to ARDEN 230.0	Circuit 1"
line_234	"Line	MEAD S 230.0 to DIAMOND 230.0	Circuit 1"
line_235	"Line	MEAD S 230.0 to DIAMOND 230.0	Circuit 2"
line_236	"Line	HARQUAHA 500.0 to DEVERS 500.0	Circuit 1"
line_237	"Line	MEAD N 230.0 to SINATRA 230.0	Circuit 1"
line_238	"Line	EQUEST N 500.0 to MEAD 500.0	Circuit 1"
line_239	"Line	SNVLY 500.0 to RACEWAY 500.0	Circuit 1"
line_240	"Line	DELANY 500.0 to SNVLY 500.0	Circuit 1"
line_241	"Line	PRECHCYN 345.0 to MAZATZAL 345.0	Circuit 1"
line_242	"Line	MAZATZAL 345.0 to PNPKAPS 345.0	Circuit 1"
line_243	"Line	JOJOBA 230.0 to PANDA 230.0	Circuit 1"
line_244	"Line	JOJOBA 230.0 to TS4 230.0	Circuit 1"
line_245	"Line	TRLBY 230.0 to TS2 230.0	Circuit 1"
line_246	"Line	TS2 230.0 to PALMVLY 230.0	Circuit 1"

line_247	"Line	MORENCI 230.0 to PD-MORNC 230.0	Circuit 1"
line_248	"Line	PANTANO 230.0 to NEWTUCSN 230.0	Circuit 1"
line_249	"Line	NEWTUCSN 230.0 to SAHUARIT 230.0	Circuit 1"
line_250	"Line	BOWIE 500.0 to PINAL_C 500.0	Circuit 1"
line_251	"Line	BOWIE 500.0 to ARROYO 500.0	Circuit 1"
line_252	"Line	MOENKOPI 500.0 to YAVAPAI 500.0	Circuit 1"
line_253	"Line	YAVAPAI 500.0 to WESTWING 500.0	Circuit 1"
line_254	"Line	DELANY 500.0 to HARQUAHA 500.0	Circuit 1"
line_255	"Line	DEERVALY 230.0 to WESTWNGE 230.0	Circuit 1"
line_256	"Line	WESTWNGW 230.0 to WESTWNGE 230.0	Circuit 1"
line_257	"Line	RACEWAY 230.0 to WESTWNGE 230.0	Circuit 1"
line_258	"Line	WESTWNGE 230.0 to EL SOL 230.0	Circuit 1"
line_259	"Line	HASSYAMP 500.0 to DELANY 500.0	Circuit 1"
line_260	"Line	PERKINS 500.0 to PERKINPS 500.0	Circuit 1"
line_261	"Line	PINAL_W 500.0 to PINAL_C 500.0	Circuit 1"
line_262	"Line	PAPAGOBT 230.0 to KYR-NEW 230.0	Circuit 1"
line_263	"Line	PINAL_C 500.0 to TORTOLIT 500.0	Circuit 1"
line_264	"Line	SAGUARO 500.0 to TORTOLIT 500.0	Circuit 1"
line_265	"Line	SAGUARO 500.0 to TORTOLIT 500.0	Circuit 2"
line_266	"Line	BICKNELL 345.0 to VAIL 345.0	Circuit 1"
line_267	"Line	GREEN-AE 345.0 to GREENLEE 345.0	Circuit 1"
line_268	"Line	GREENLEE 345.0 to COPPERVR 345.0	Circuit 1"
line_269	"Line	GREENLEE 345.0 to WILLOW 345.0	Circuit 1"
line_270	"Line	GREENLEE 345.0 to WINCHSTR 345.0	Circuit 1"
line_271	"Line	HIDALGO 345.0 to GREENLEE 345.0	Circuit 1"
line_272	"Line	MCKINLEY 345.0 to SPRINGR 345.0	Circuit 1"
line_273	"Line	MCKINLEY 345.0 to SPRINGR 345.0	Circuit 2"
line_274	"Line	PINALWES 345.0 to SOUTH 345.0	Circuit 1"
line_275	"Line	SAN_JUAN 345.0 to MCKINLEY 345.0	Circuit 1"
line_276	"Line	SAN_JUAN 345.0 to MCKINLEY 345.0	Circuit 2"
line_277	"Line	SOUTH 345.0 to GATEWAY 345.0	Circuit 1"
line_278	"Line	SOUTH 345.0 to GATEWAY 345.0	Circuit 2"
line_279	"Line	SPRINGR 345.0 to CORONADO 345.0	Circuit 1"
line_280	"Line	SPRINGR 345.0 to GREENLEE 345.0	Circuit 1"
line_281	"Line	SPRINGR 345.0 to LUNA 345.0	Circuit 1"
line_282	"Line	SPRINGR 345.0 to VAIL2 345.0	Circuit 1"
line_283	"Line	TORTOLIT 345.0 to NLOOP345 345.0	Circuit 1"
line_284	"Line	VAIL 345.0 to SOUTH 345.0	Circuit 1"
line_285	"Line	WESTWING 345.0 to PINALWES 345.0	Circuit 1"
line_286	"Line	WESTWING 345.0 to SOUTH 345.0	Circuit 1"
line_287	"Line	WHTHILLS 345.0 to MEAD 345.0	Circuit 1"
line_288	"Line	WHTHILLS 345.0 to PEACOCK 345.0	Circuit 1"
line_289	"Line	WILLOW 345.0 to BOWIE 345.0	Circuit 1"
line_290	"Line	WILLOW 345.0 to BOWIE 345.0	Circuit 2"
line_291	"Line	WINCHSTR 345.0 to VAIL 345.0	Circuit 1"
line_292	"Line	WINCHSTR 345.0 to WILLOW 345.0	Circuit 1"
line_293	"Line	FRANCONI 230.0 to GRIFFITH 230.0	Circuit 1"
line_294	"Line	FRANCONI 230.0 to N.HAVASU 230.0	Circuit 1"
line_295	"Line	MCCONICO 230.0 to MERC230 230.0	Circuit 1"
line_296	"Line	WHTHILLS 230.0 to MERC230 230.0	Circuit 1"

line_297	"Line	RACEWAY 230.0 to RACEWYWA 230.0	Circuit 1"
line_298	"Line	PRSCOTWA 230.0 to PRESCOTT 230.0	Circuit 1"
line_299	"Line	PRSCOTWA 230.0 to RNDVLYTP 230.0	Circuit 1"
line_300	"Line	GAVLINWA 230.0 to GAVILNPK 230.0	Circuit 1"
line_301	"Line	GAVLINWA 230.0 to PINPK 230.0	Circuit 1"
line_302	"Line	GAVLINWA 230.0 to PRSCOTWA 230.0	Circuit 1"
line_303	"Line	N.WADDEL 230.0 to RACEWYWA 230.0	Circuit r1
line_304	"Line	HASSYAMP 500.0 to N.GILA 500.0	Circuit 2"
line_305	"Line	DBG 230.0 to PINAL_C 230.0	Circuit 1"
line_306	"Line	SUN ARIZ 230.0 to PINAL_C 230.0	Circuit 1"
line_307	"Line	JOJOBA 500.0 to PANDA 500.0	Circuit 1"
line_308	"Line	JOJOBA 500.0 to PANDA 500.0	Circuit 2"
line_309	"Line	JOJOBA 500.0 to KYRENE 500.0	Circuit 1"
line_310	"Line	ABEL 230.0 to RANDOLPH 230.0	Circuit 1"
line_311	"Line	HASSYAMP 500.0 to JOJOBA 500.0	Circuit 1"
line_312	"Line	PINAL_C 230.0 to RANDOLPH 230.0	Circuit 1"
line_313	"Line	ANDERSON 230.0 to KYR-NEW 230.0	Circuit 1"
line_314	"Line	SANTAN 230.0 to RS-24 230.0	Circuit 1"
line_315	"Line	SCHRADER 230.0 to RS-24 230.0	Circuit 1"
line_316	"Line	SILVERKG 230.0 to GOLDFELD 230.0	Circuit 1"
line_317	"Line	ABEL 230.0 to DINOSAUR 230.0	Circuit 1"
line_318	"Line	ABEL 230.0 to RS-24 230.0	Circuit 1"
line_319	"Line	ABEL 230.0 to RS-24 230.0	Circuit 2"
line_320	"Line	RACEWYWA 230.0 to WESTWNGE 230.0	Circuit 1"
line_321	"Line	CASGRAPS 230.0 to MILLIGAN 230.0	Circuit 1"
line_322	"Line	TS12 230.0 to SAGUARO 230.0	Circuit 1"
line_323	"Line	MILLIGAN 230.0 to TS12 230.0	Circuit 1"
line_324	"Line	VERDE S 230.0 to VERDE N 230.0	Circuit 1"
line_325	"Line	VERDE S 230.0 to COCONINO 230.0	Circuit 1"
line_326	"Line	GILA 230.0 to NGL-E 230.0	Circuit 1"
line_327	"Line	GILA 230.0 to NGL-W 230.0	Circuit 1"
line_328	"Line	GILA 230.0 to TS8 230.0	Circuit 1"
line_329	"Line	SLRC 230.0 to TS8 230.0	Circuit 1"
line_330	"Line	SLRC 230.0 to GILA 230.0	Circuit 1"
line_331	"Line	GLENDALE 230.0 to GLENDALW 230.0	Circuit 1"
line_332	"Line	GLENDALW 230.0 to AGUAFRIA 230.0	Circuit 1"
line_333	"Line	BUCKEYE2 230.0 to LIBERTY 230.0	Circuit 1"
line_334	"Line	EAGLEYE 230.0 to BUCKEYE2 230.0	Circuit 1"
line_335	"Line	BUCKEYE 230.0 to BUCKEYE2 230.0	Circuit 1"
line_336	"Line	CORONADO 500.0 to CHOLLA 500.0	Circuit 1"
line_337	"Line	PERKINPS 500.0 to WESTWING 500.0	Circuit 1"
line_338	"Line	SILVERKG 230.0 to GOLDFELD 230.0	Circuit 2"
tran_339	"Tran	CHOLLA 500.00 to CHOLLA 345.	Circuit 1"
tran_340	"Tran	CHOLLA 500.00 to CHOLLA 345.	Circuit 2"
tran_341	"Tran	FOURCORN 500.00 to FOURCORN 345.	Circuit 1"
tran_342	"Tran	WESTWING 500.00 to WESTWNGW 230.	Circuit 1"
tran_343	"Tran	WESTWING 500.00 to WESTWNGW 230.	Circuit 2"
tran_344	"Tran	PANDA 500.00 to PANDA 230.	Circuit 1"
tran_345	"Tran	FOURCORN 345.00 to FOURCORN 230.	Circuit 1"
tran_346	"Tran	FOURCORN 345.00 to FOURCORN 230.	Circuit 2"

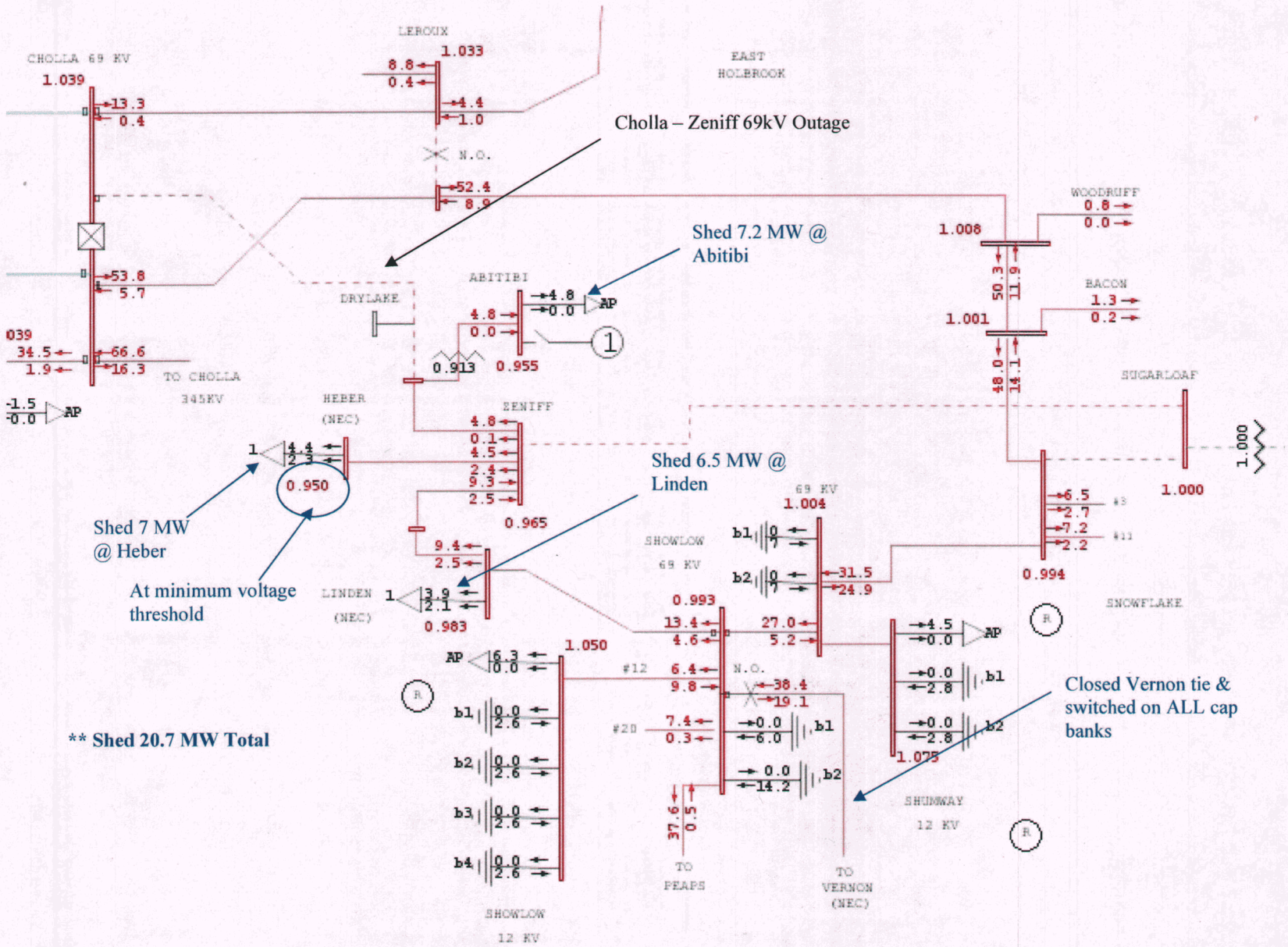
tran_347	"Tran	PNPKAPS 345.00 to PNPKAPS 230.	Circuit 1"
tran_348	"Tran	PNPKAPS 345.00 to PPAPS N 230.	Circuit 2"
tran_349	"Tran	PNPKAPS 345.00 to PPAPS C 230.	Circuit 3"
tran_350	"Tran	KYRENE 500.00 to KYRENE 230.	Circuit 6"
tran_351	"Tran	KYRENE 500.00 to KYRENE 230.	Circuit 7"
tran_352	"Tran	PERKINS 500.00 to PERK PS1 500.	Circuit 1"
tran_353	"Tran	PERKINS 500.00 to PERK PS2 500.	Circuit 1"
tran_354	"Tran	SILVERKG 500.00 to SILVERKG 230.	Circuit 1"
tran_355	"Tran	BROWNING 500.00 to BROWNING 230.	Circuit 1"
tran_356	"Tran	BROWNING 500.00 to BROWNING 230.	Circuit 2"
tran_357	"Tran	RUDD 500.00 to RUDD 230.	00 Circuit
tran_358	"Tran	RUDD 500.00 to RUDD 230.	Circuit 2"
tran_359	"Tran	RUDD 500.00 to RUDD 230.	Circuit 3"
tran_360	"Tran	MESQUITE 500.00 to MESQUITE 230.	Circuit 1"
tran_361	"Tran	COPPERVR 345.00 to COPPERVR 230.	Circuit 1"
tran_362	"Tran	BICKNELL 345.00 to BICKNELL 230.	Circuit 1"
tran_363	"Tran	GREEN-AE 345.00 to GREEN-AE 230.	Circuit 1"
tran_364	"Tran	MEAD 345.00 to MEAD N 230.	Circuit 1"
tran_365	"Tran	MEAD 500.00 to MEAD N 230.	Circuit 1"
tran_366	"Tran	LIBERTY 345.00 to LIBTYPHS 230.	Circuit 1"
tran_367	"Tran	LIBTYPHS 230.00 to LIBERTY 230.	Circuit 1"
tran_368	"Tran	PEACOCK 345.00 to PEACOCK 230.	Circuit 1"
tran_369	"Tran	GLEN PS 230.00 to GLENCANY 230.	Circuit 1"
tran_370	"Tran	GLENCANY 345.00 to GLENCANY 230.	Circuit 1"
tran_371	"Tran	GLENCANY 345.00 to GLENCANY 230.	Circuit 2"
tran_372	"Tran	PINPKBRB 345.00 to PINPK 230.	Circuit 1"
tran_373	"Tran	PINPKBRB 345.00 to PINPK 230.	Circuit 2"
tran_374	"Tran	PINPKBRB 345.00 to PINPK 230.	Circuit 3"
tran_375	"Tran	SHIPROCK 345.00 to SHIPROCK 230.	Circuit 1"
tran_376	"Tran	RUDD 500.00 to RUDD 230.	Circuit 4"
tran_377	"Tran	SNVLY 500.00 to SNVLY 230.	Circuit 1"
tran_378	"Tran	SNVLY 500.00 to SNVLY 230.	Circuit 2"
tran_379	"Tran	RACEWAY 500.00 to RACEWAY 230.	Circuit 1"
tran_380	"Tran	RACEWAY 500.00 to RACEWAY 230.	Circuit 2"
tran_381	"Tran	PNPKAPS 500.00 to PNPKAPS 230.	Circuit 1"
tran_382	"Tran	PNPKAPS 500.00 to PPAPS C 230.	Circuit 2"
tran_383	"Tran	PNPKAPS 500.00 to PPAPS N 230.	Circuit 3"
tran_384	"Tran	MEAD 500.00 to MEAD N 230.	Circuit 2"
tran_385	"Tran	CHOLLA 345.00 to CHOLLA 230.	Circuit 1"
tran_386	"Tran	CHOLLA 345.00 to CHOLLA 230.	Circuit 2"
tran_387	"Tran	MEAD S 230.00 to MEAD 287.	Circuit 1"
tran_388	"Tran	SHIP PS 230.00 to SHIPROCK 230.	Circuit 1"
tran_389	"Tran	ARROYO 500.00 to ARROYO 345.	Circuit 1"
tran_390	"Tran	ARROYO 500.00 to ARROYO 345.	Circuit 2"
tran_391	"Tran	WESTWING 500.00 to WESTWNGE 230.	Circuit 1"
tran_392	"Tran	YAVAPAI 500.00 to YAVAPAI 230.	Circuit 1"
tran_393	"Tran	YAVAPAI 500.00 to YAVAPAI 230.	Circuit 2"
tran_394	"Tran	CORONADO 500.00 to CORONADO 345.	Circuit 1"
tran_395	"Tran	CORONADO 500.00 to CORONADO 345.	Circuit 2"
tran_396	"Tran	PINAL_W 500.00 to PINALWES 345.	Circuit 1"

tran_397	"Tran	TORTOLIT 500.00 to TORTOLIT 345.	Circuit 1"
tran_398	"Tran	WESTWING 500.00 to WESTWING 345.	Circuit 1"
tran_399	"Tran	WHTHILLS 345.00 to WHTHILLS 230.	Circuit 1"
tran_400	"Tran	WINCHSTR 345.00 to WINCHSTR 230.	Circuit 1"
tran_401	"Tran	BOWIE 500.00 to BOWIE 345.	Circuit 1"
tran_402	"Tran	BOWIE 500.00 to BOWIE 345.	Circuit 2"
tran_403	"Tran	GREEN-AE 345.00 to GREEN-AE 230.	Circuit 2"
tran_404	"Tran	KYRENE 500.00 to KYR-NEW 230.	Circuit 8"
tran_405	"Tran	PINAL_C 500.00 to PINAL_C 230.	Circuit 1"
tran_406	"Tran	NGL-E 230.00 to N.GILA 500.	Circuit 1"
tran_407	"Tran	NGL-W 230.00 to N.GILA 500.	Circuit 1"
tran_408	"Tran	ABEL 500.00 to ABEL 230.	Circuit 1"
tran_409	"Tran	COPPERVR 345.00 to COPPERVR 230.	Circuit 2"

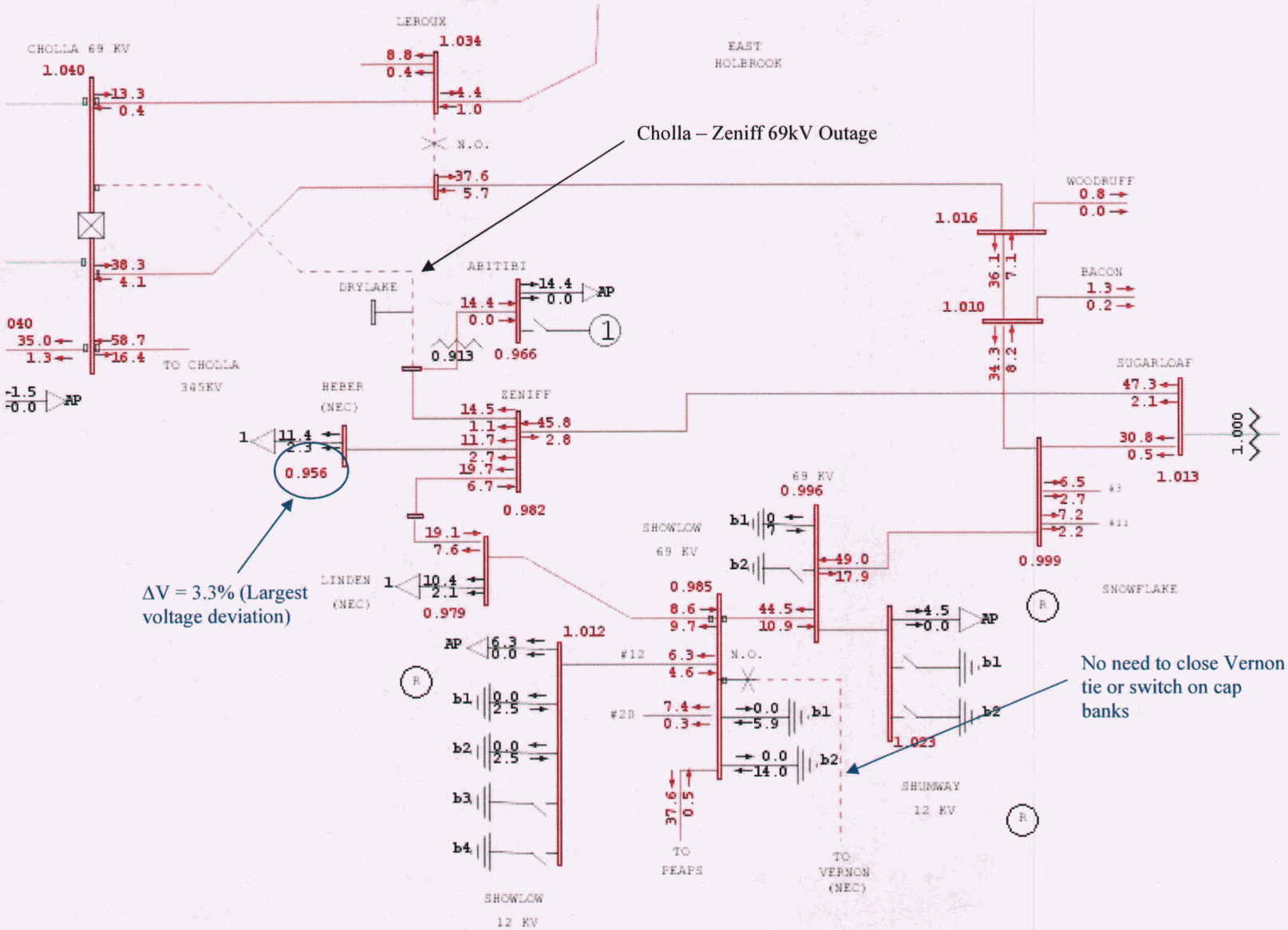
APPENDIX B

Power Flow Maps

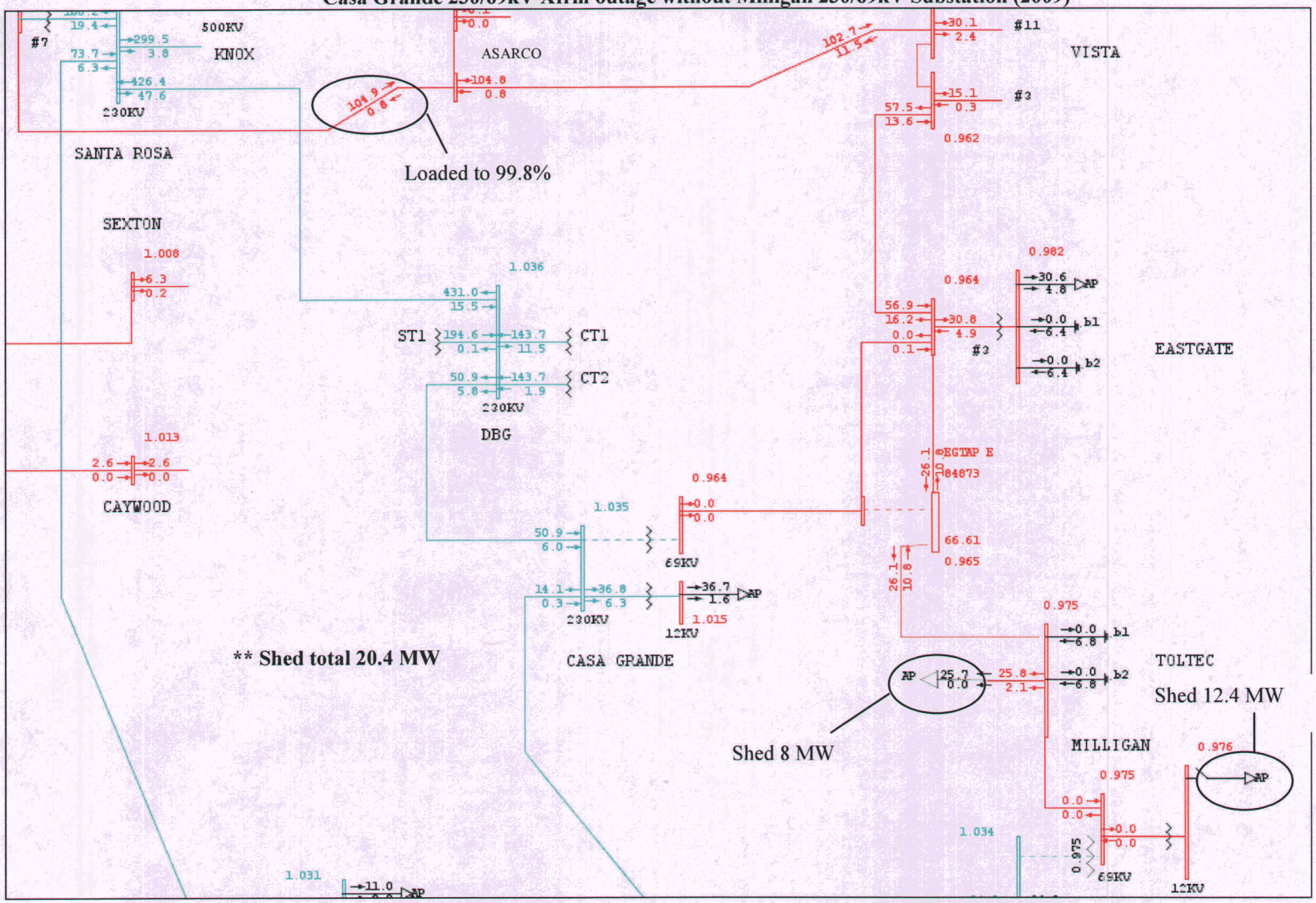
2009 Without Sugarloaf 500/69kV Substation



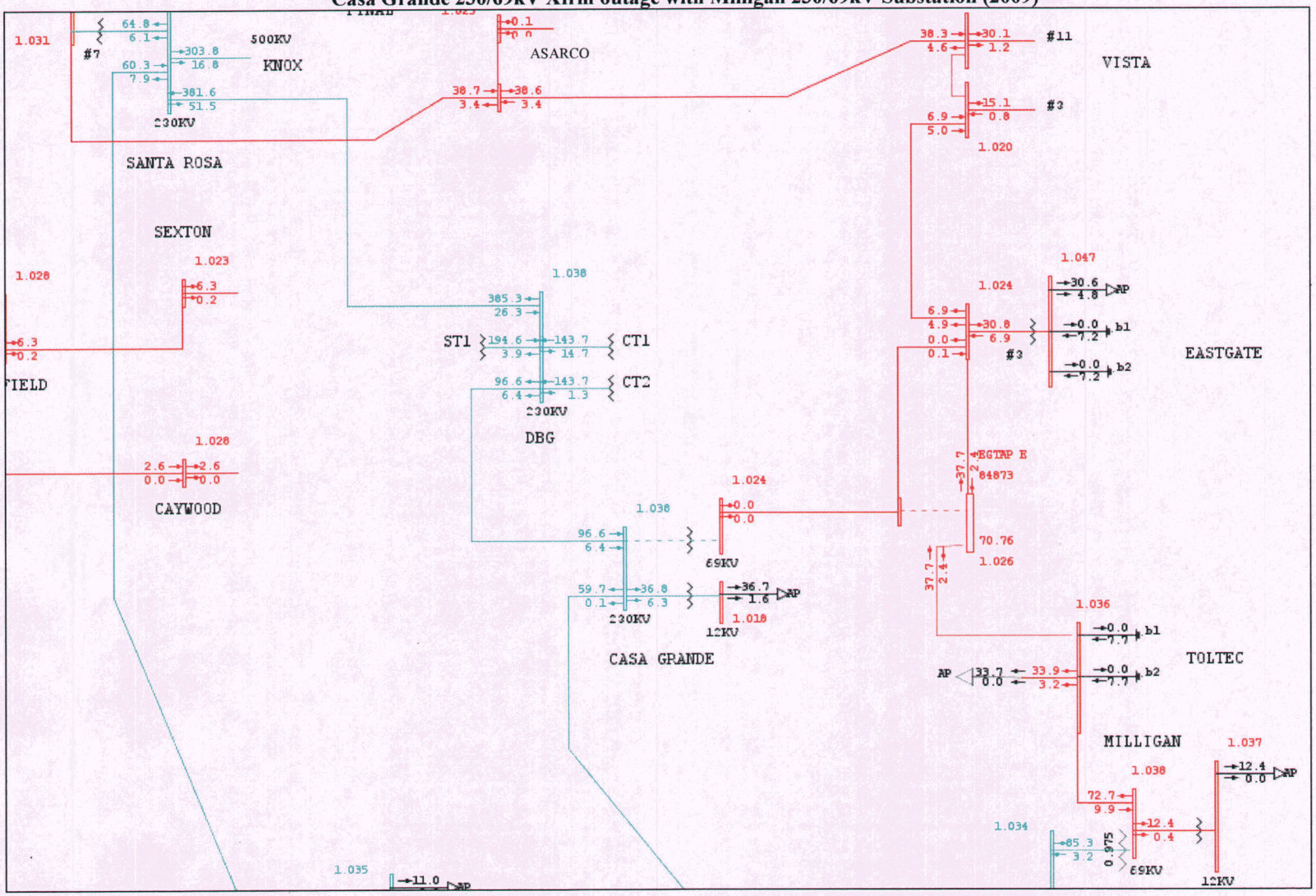
2009 With Sugarloaf 500/69kV Substation



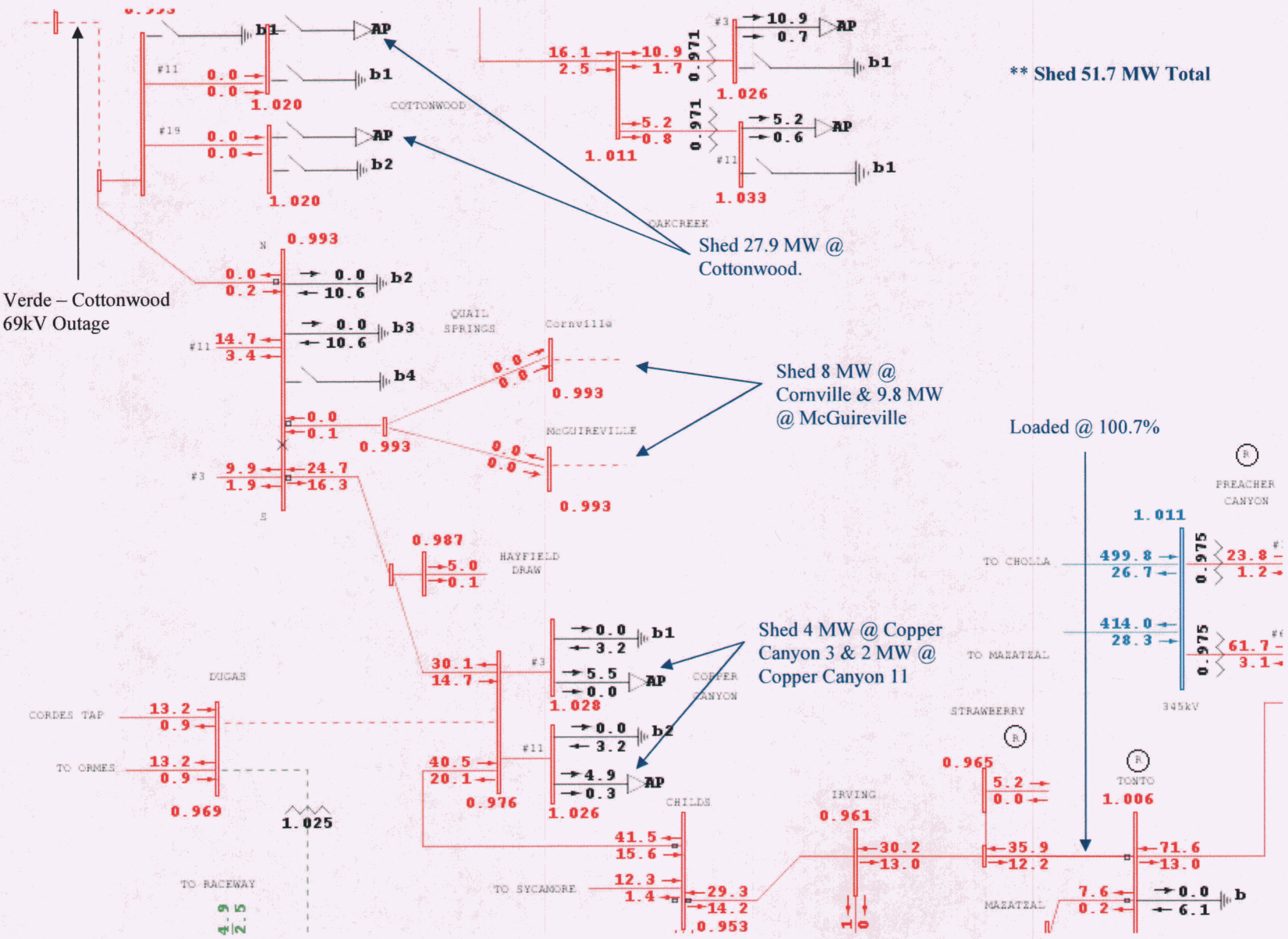
Casa Grande 230/69kV Xfrm outage without Milligan 230/69kV Substation (2009)



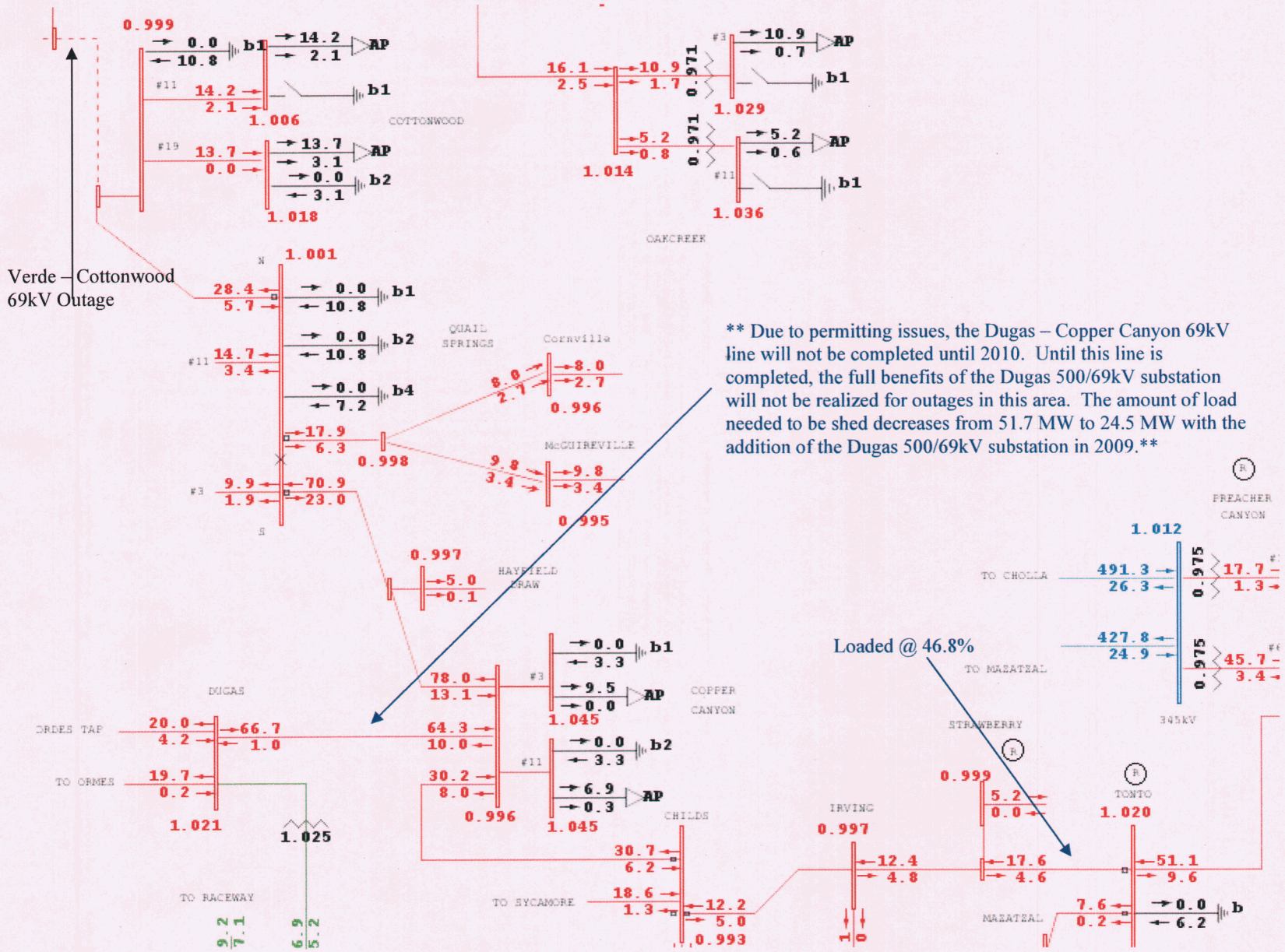
Casa Grande 230/69kV Xfrm outage with Milligan 230/69kV Substation (2009)



2009 Without Dugas 500/69kV Substation

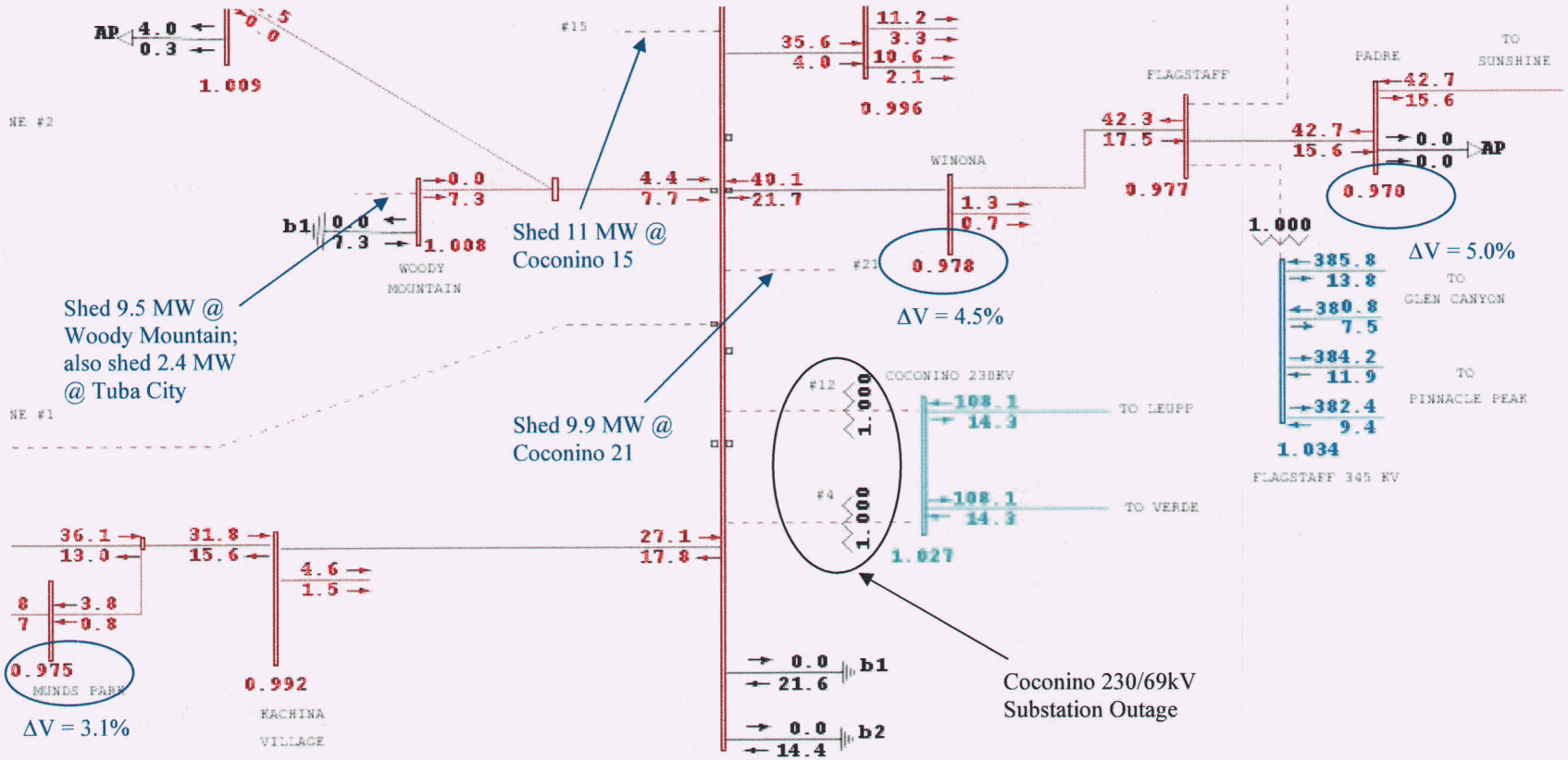


2009 With Dugas 500/69kV Substation



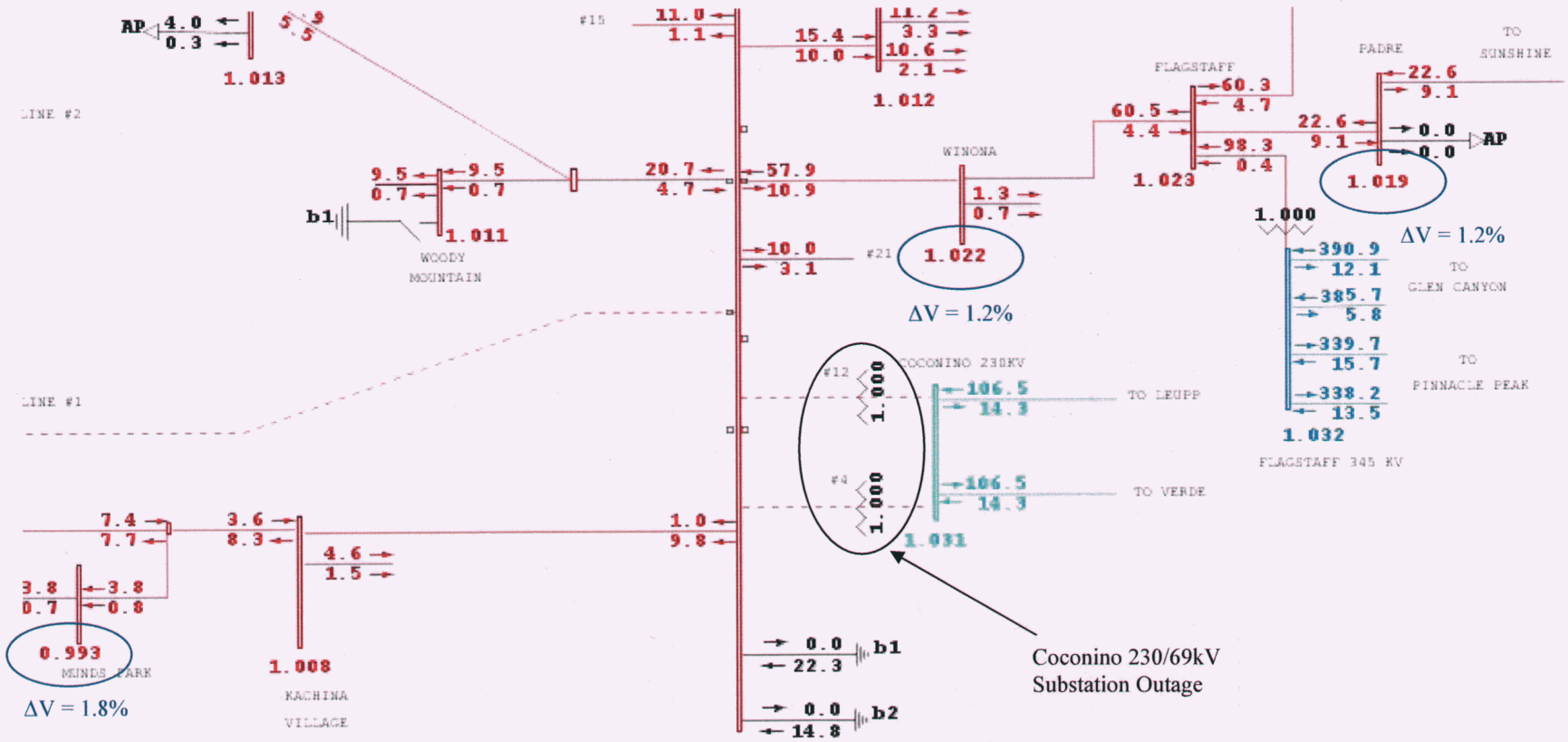
** Due to permitting issues, the Dugas – Copper Canyon 69kV line will not be completed until 2010. Until this line is completed, the full benefits of the Dugas 500/69kV substation will not be realized for outages in this area. The amount of load needed to be shed decreases from 51.7 MW to 24.5 MW with the addition of the Dugas 500/69kV substation in 2009.**

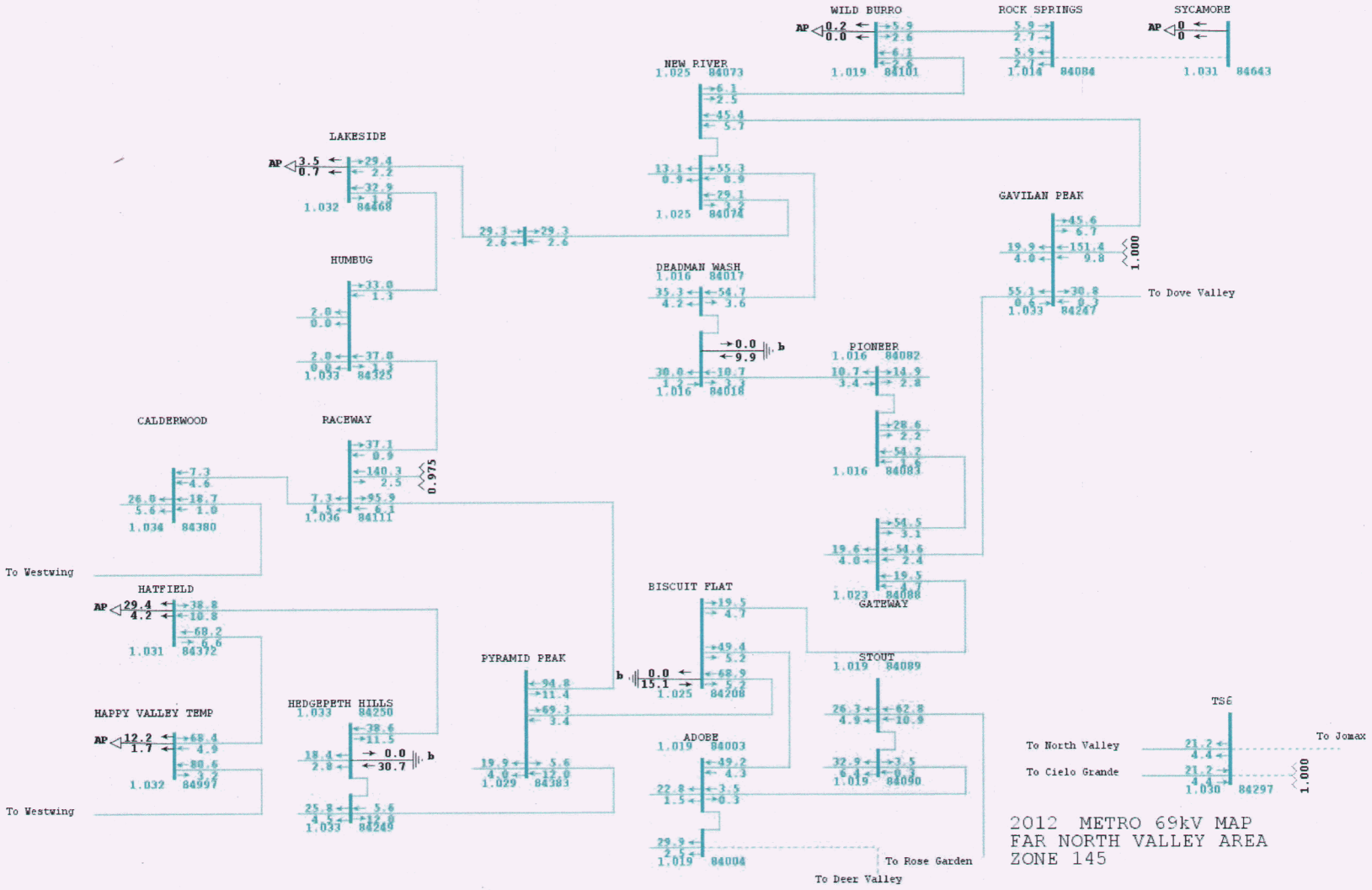
2012 Without Flagstaff 345/69kV Substation



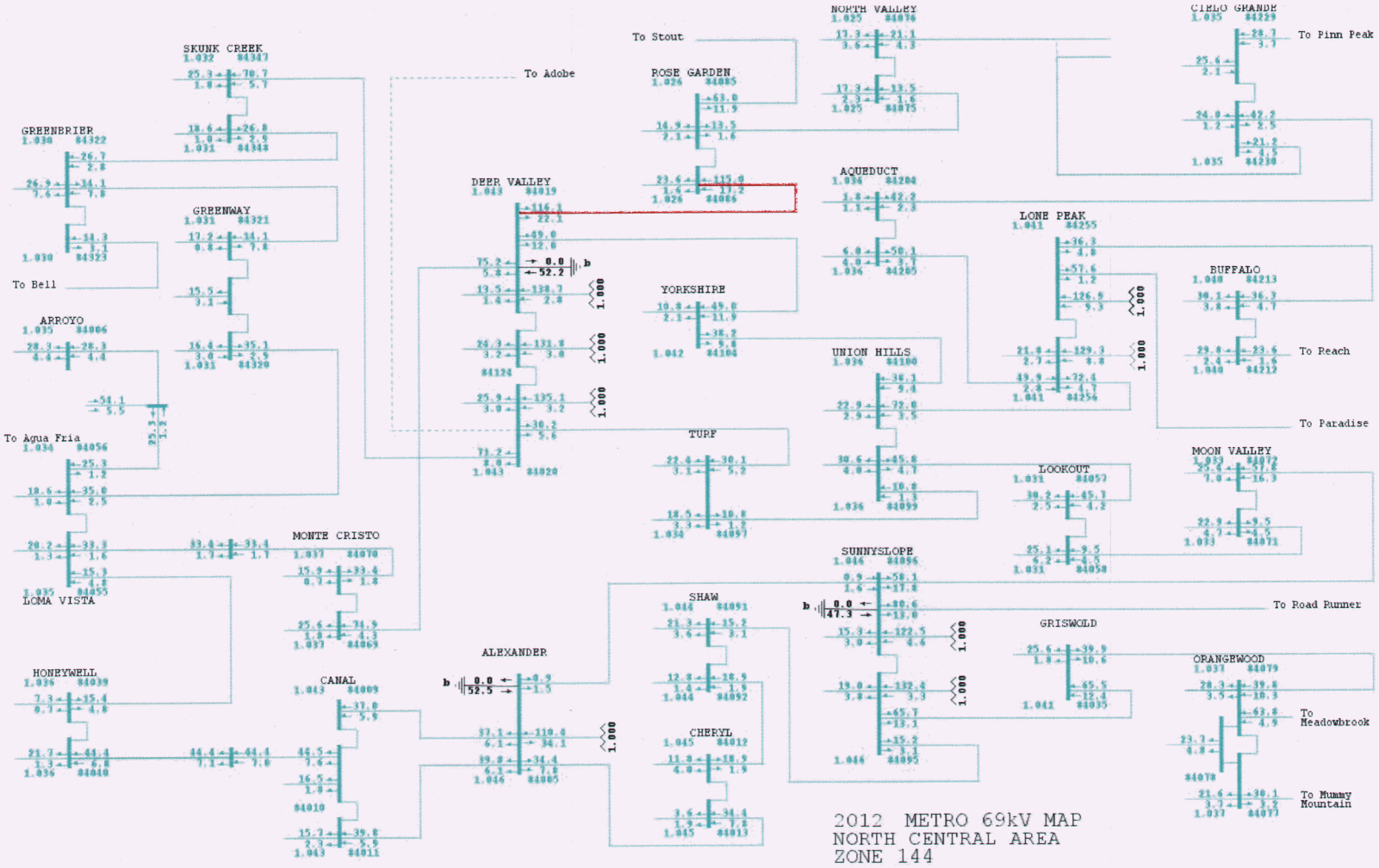
**** Shed 32.8 MW Total**

2012 With Flagstaff 345/69kV Substation

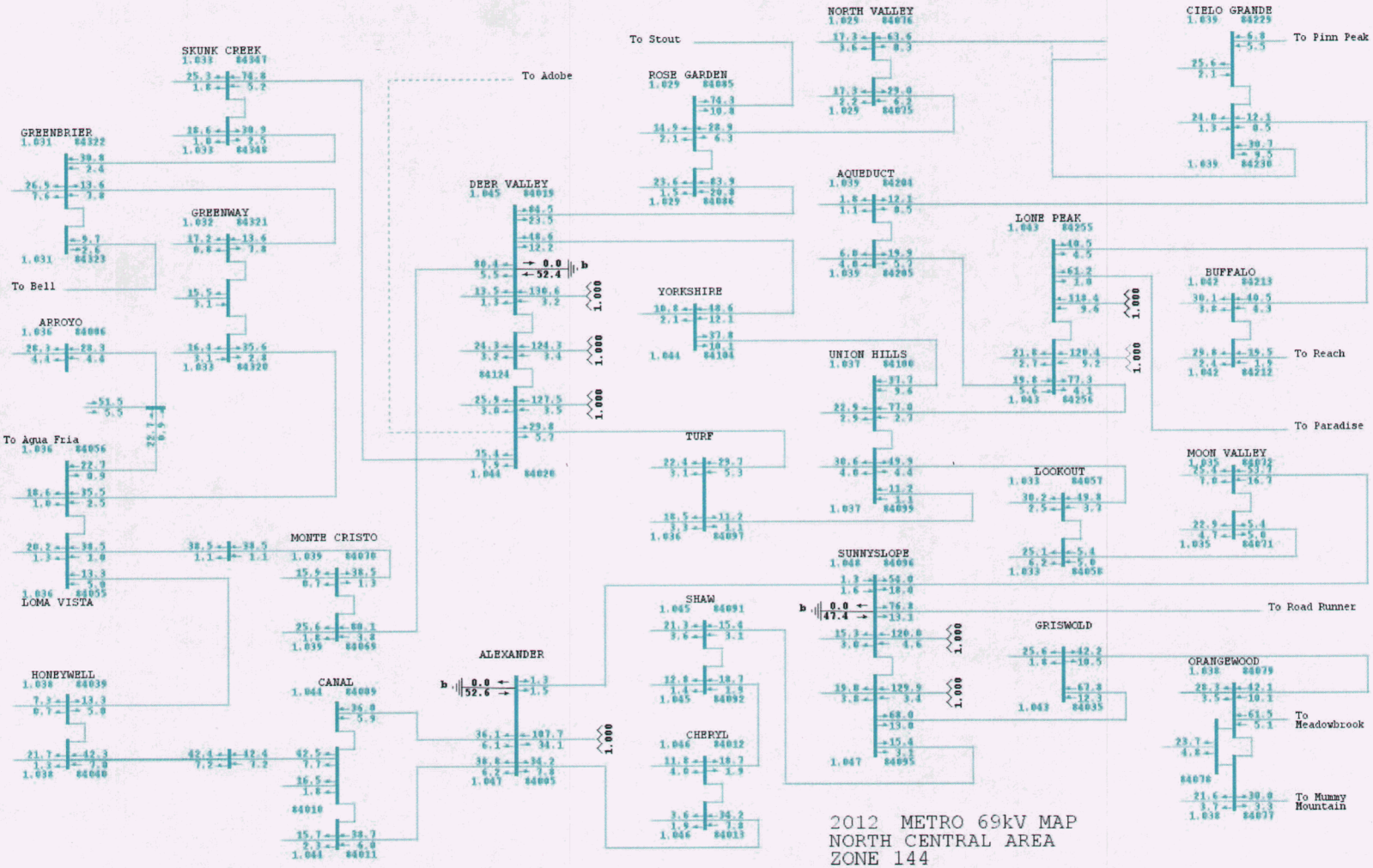




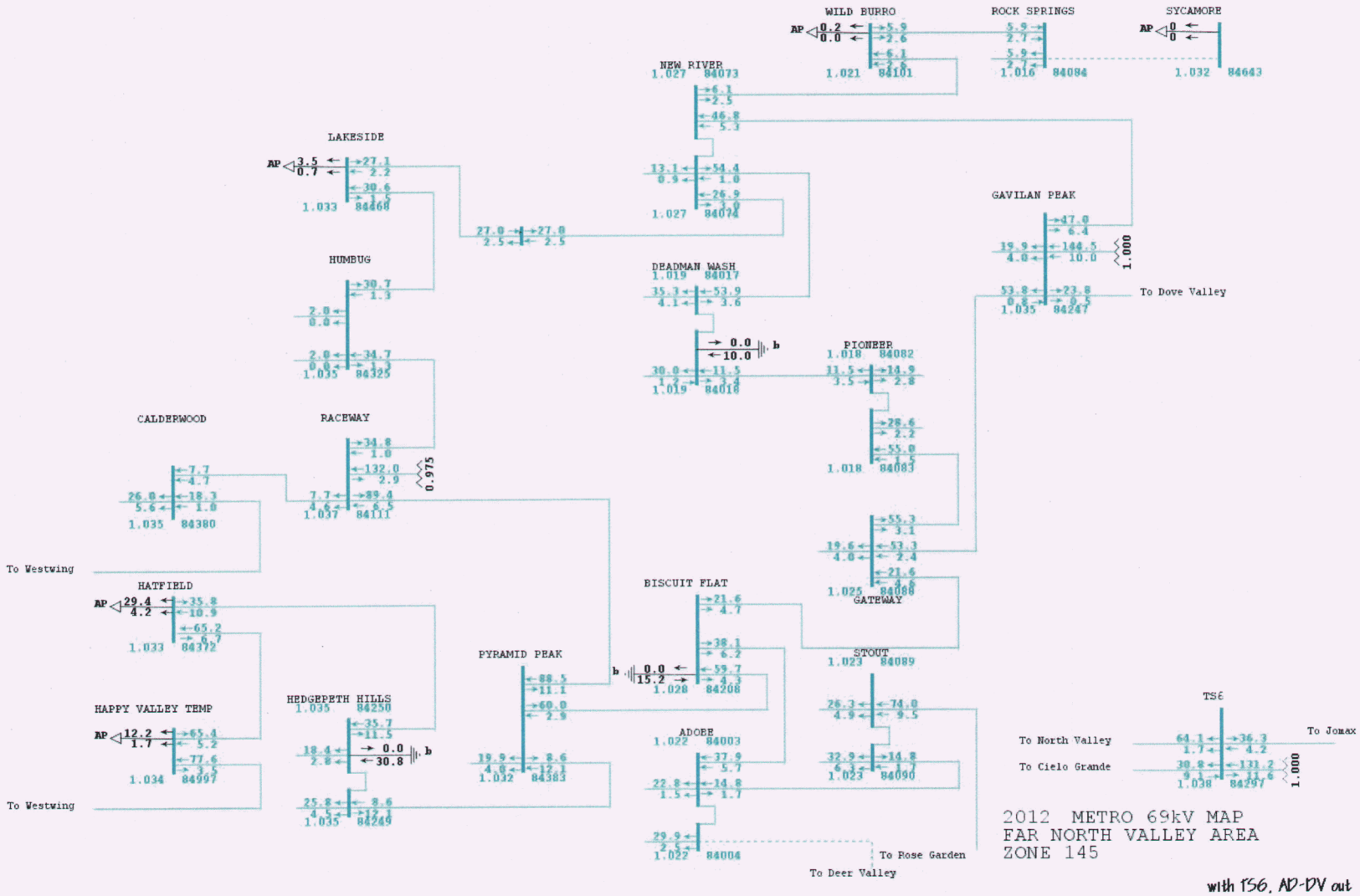
no TS6, AD-DV out

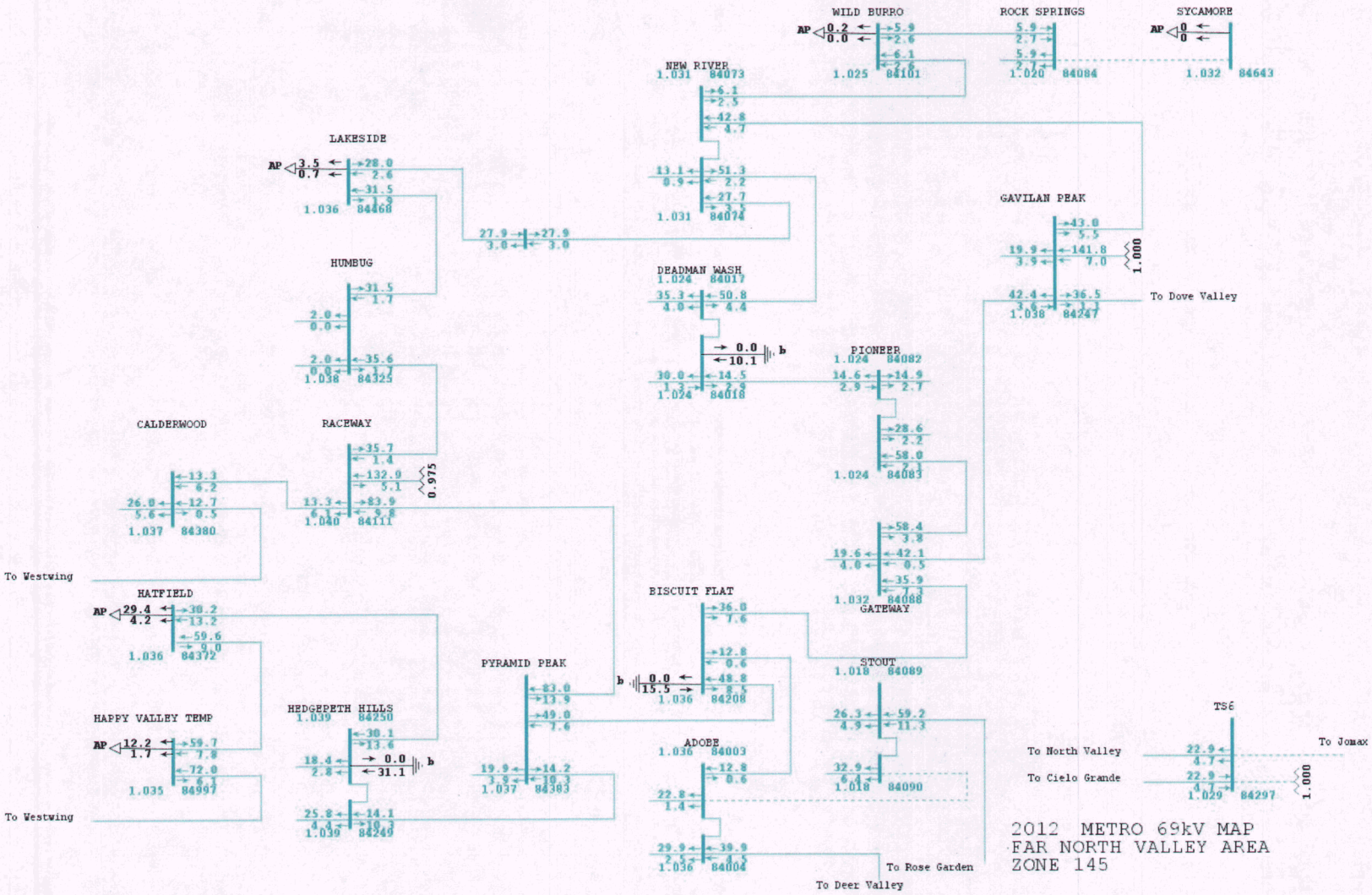


no 156, AD-DV out



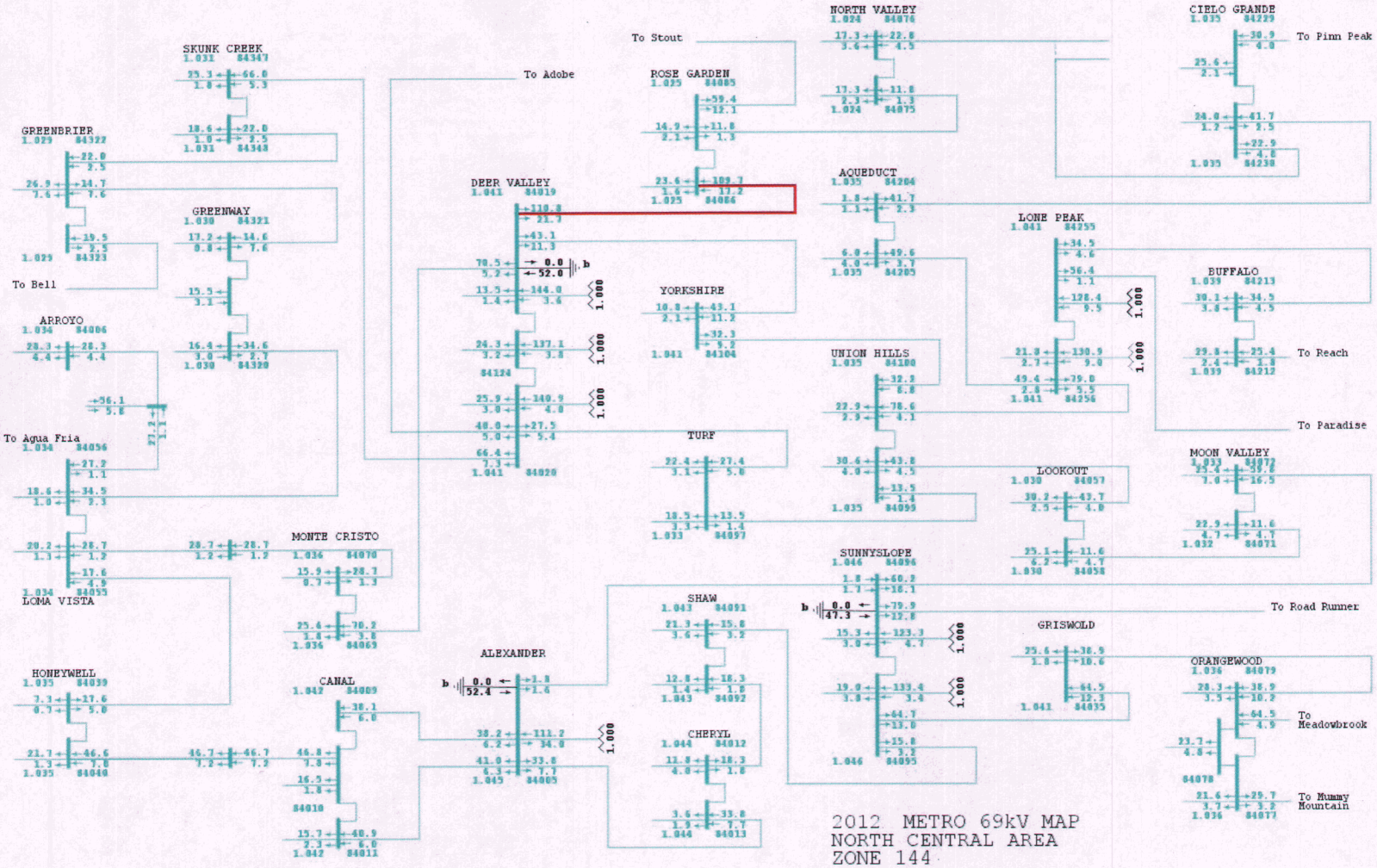
with TS6, AD-DV out


WILD BURRO
ROCK SPRINGS
SYCAMORE
NEW RIVER
LAKESIDE
HUMBUG
DEADMAN WASH
GAVILAN PEAK
To Dove Valley
PIONEER
CALDERWOOD
RACEWAY
To Westwing
HATFIELD
BISCUIT FLAT
GATEWAY
STOUT
PYRAMID PEAK
HEDGEPETH HILLS
HAPPY VALLEY TEMP
ADOBE
TS6
To North Valley
To Cielo Grande
To Jomax
To Westwing
To Rose Garden
To Deer Valley
2012 METRO 69kV MAP
FAR NORTH VALLEY AREA
ZONE 145
with TS6, AD-DV out



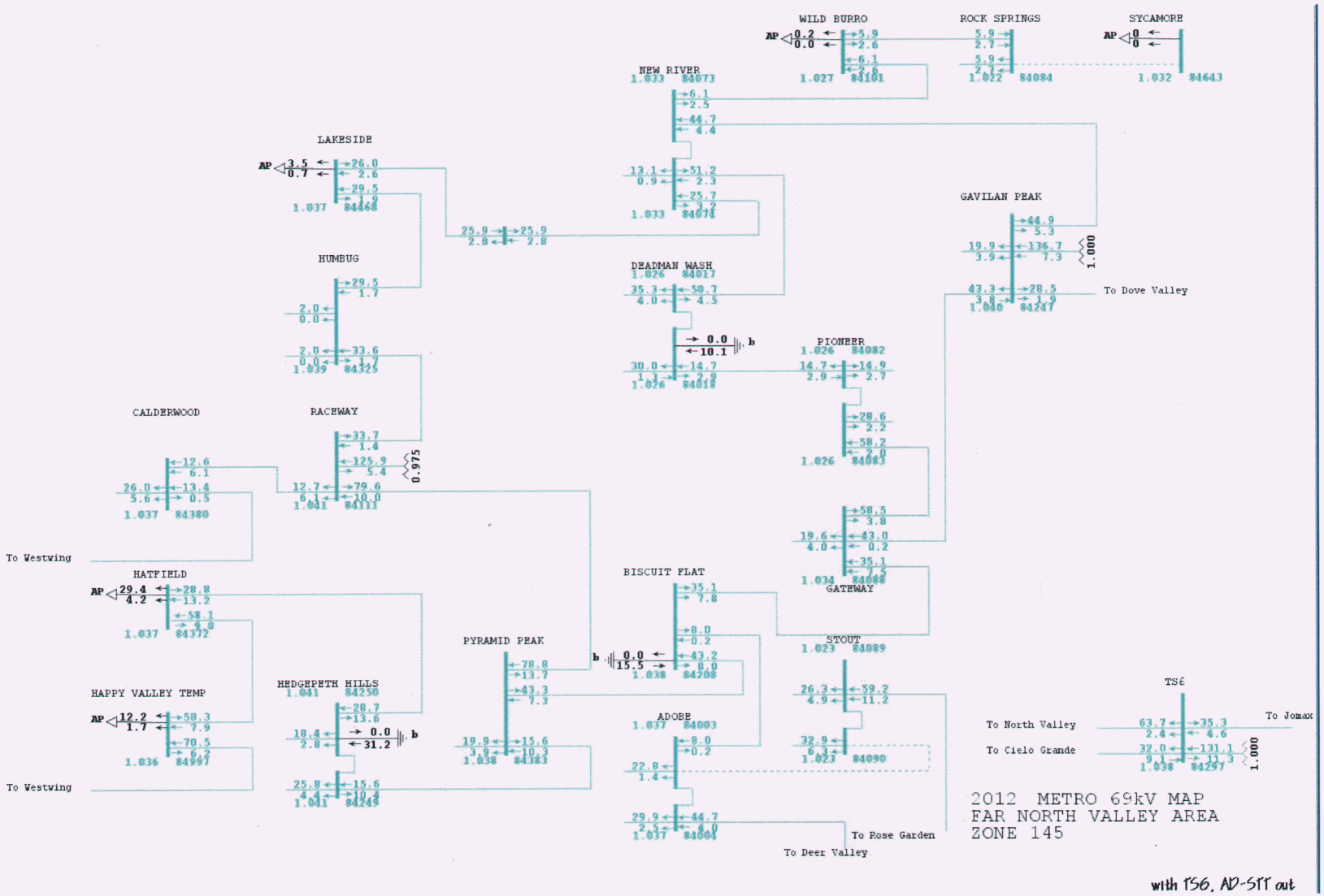
2012 METRO 69kV MAP
FAR NORTH VALLEY AREA
ZONE 145

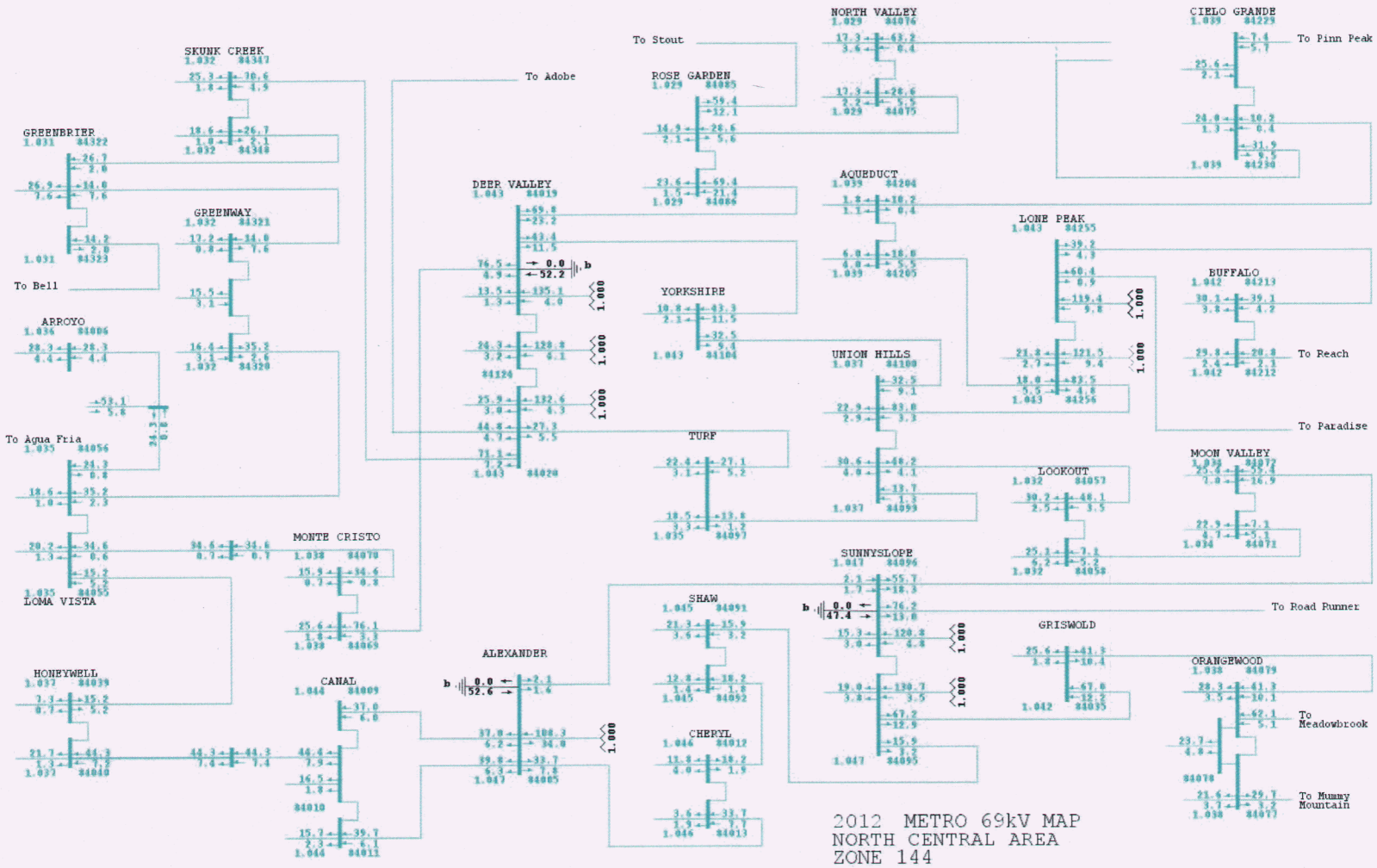
no TS6, AD-STT out



2012 METRO 69kV MAP
NORTH CENTRAL AREA
ZONE 144

no 156, AD-SIT out

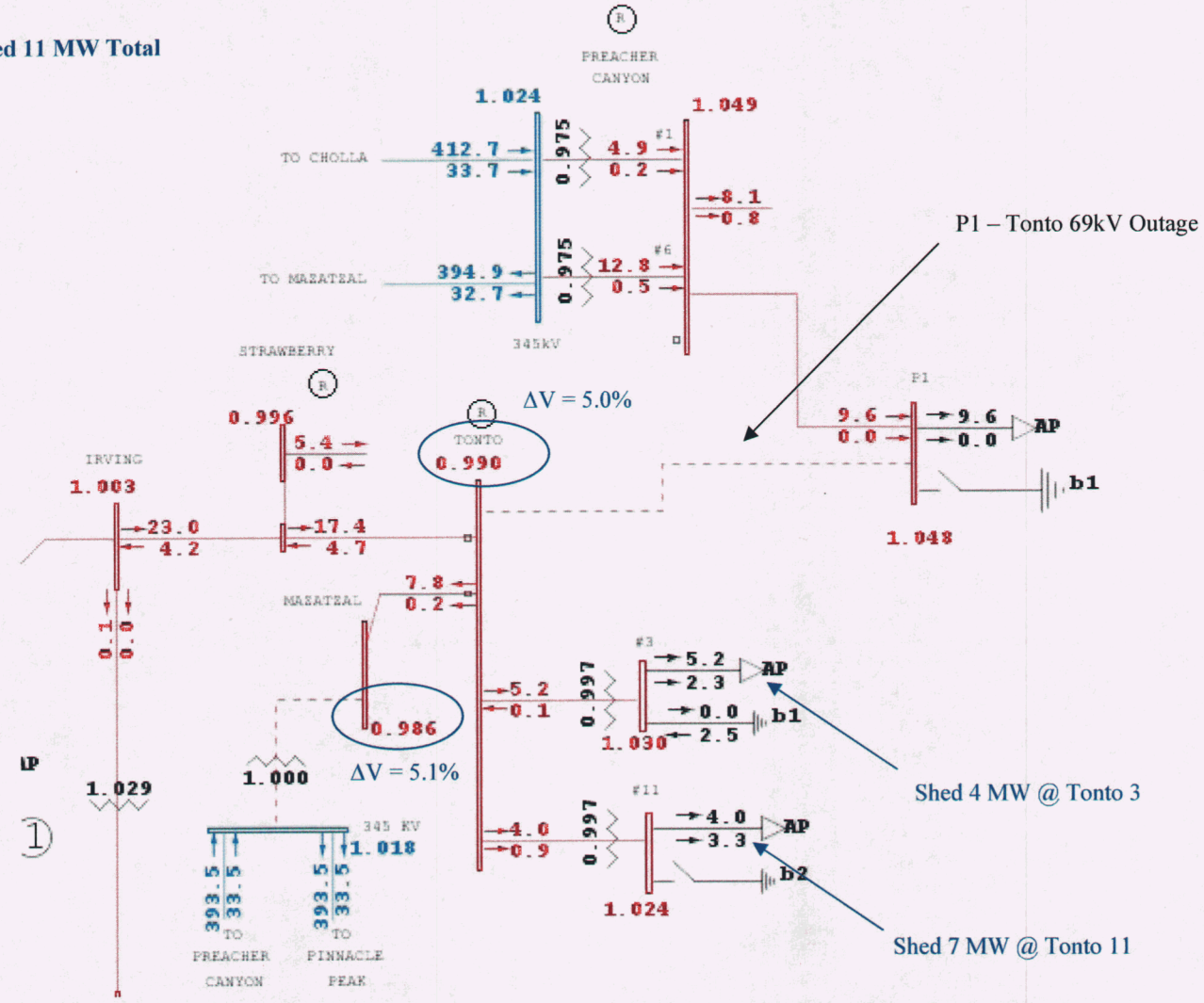

WILD BURRO
ROCK SPRINGS
SYCAMORE
NEW RIVER
LAKESIDE
GAVILAN PEAK
HUMBUG
DEADMAN WASH
PIONEER
CALDERWOOD
RACEWAY
To Dove Valley
To Westwing
HATFIELD
BISCUIT FLAT
GATEWAY
PYRAMID PEAK
STOUT
HEDGEPETH HILLS
HAPPY VALLEY TEMP
ADOBE
TS6
To North Valley
To Jomax
To Cielo Grande
To Westwing
To Rose Garden
To Deer Valley
2012 METRO 69kV MAP
FAR NORTH VALLEY AREA
ZONE 145
with TS6, AD-STT out



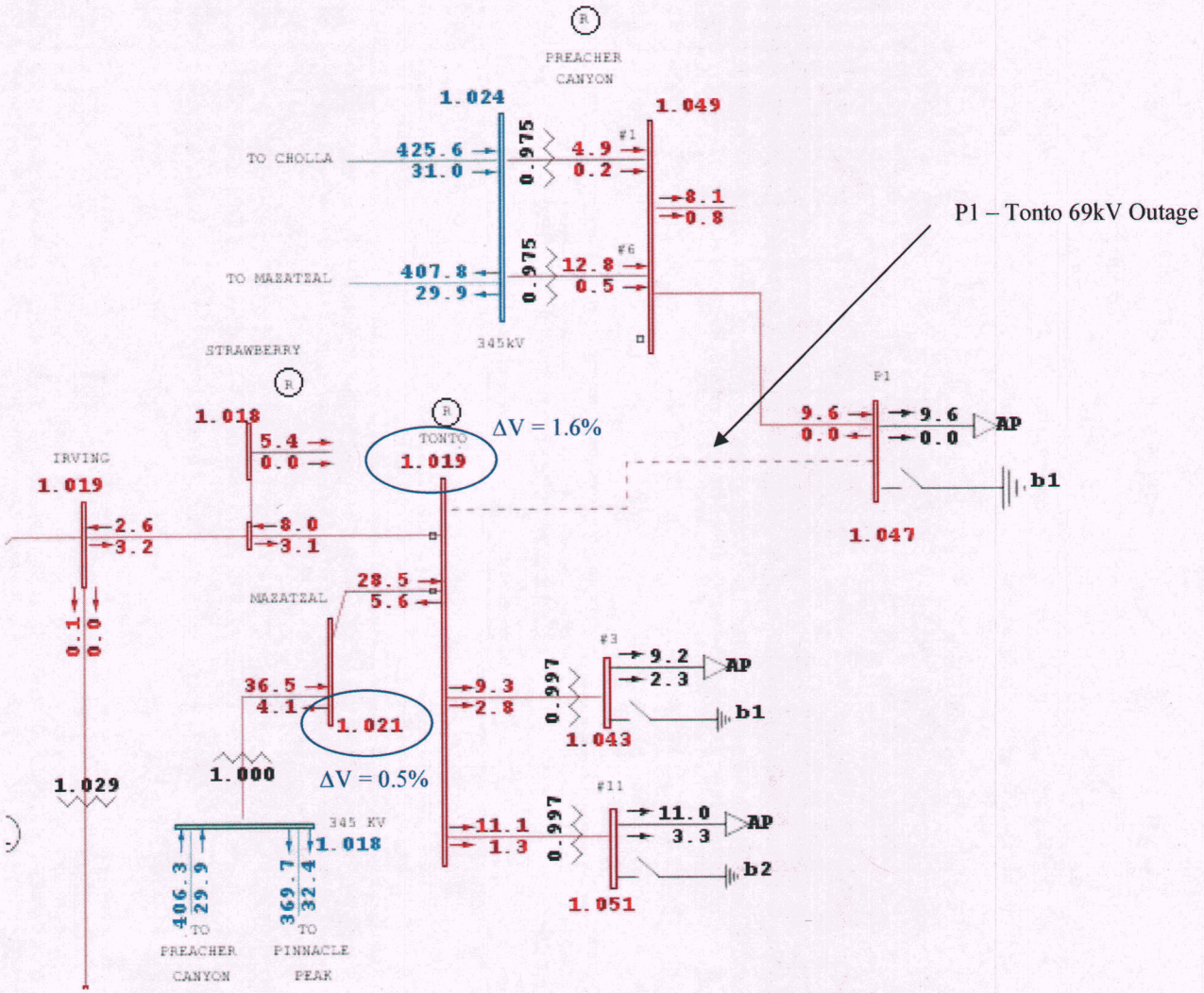
with TS6, AD-STT out

2013 Without Mazatzal 345/69kV Substation

** Shed 11 MW Total



2013 With Mazatzal 345/69kV Substation



APPENDIX C

2013
Stability Plots

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Simulation			Page
Transmission Element Outages			
From Bus (Fault Location)	To Bus	kV	
Avery	Raceway	230	1
Avery	TS6	230	2
Casa Grande	Desert Basin	230	3
Casa Grande	Milligan	230	4
Cactus	Ocotillo	230	5
Cactus	Pinnacle Peak	230	6
Country Club	Grand Terminal	230	7
Country Club	Lincoln Street	230	8
Cholla	Four Corners	345	9
Cholla	LEUPP	230	10
Cholla	Preacher Canyon	345	11
Cholla	Pinnacle Peak	345	12
Cholla	Saguaro	500	13
Cholla	Sugar Loaf	500	14
Coconino	Verde	230	15
Coronado	Sugar Loaf	500	16
Delany	Harquhala	500	17
Delany	Hassayampa	500	18
Delany	Sun Valley	500	19
DRPP	FCW	500	20
Dugas	Raceway	500	21
Deer Valley	Westwing	230	22
El Sol	Agua Fria	230	23
Four Corners	Cholla	230	24
Four Corners	Moenkopi	500	25
Glendale	Agua Fria	230	26
Glendale	Grand Terminal	230	27
Gila River	Gilabend	230	28
Hassayampa	Jojoba	500	29
Hassayampa	N.Gila	500	30
Jojoba	Gila River	500	31
Jojoba	TS4	230	32
Jojoba	Kyrene	500	33
Kyrene	Ocotillo	230	34
Kyrene	Browning	500	35
LEUPP	Coconino	230	36
Liberty	TS4	230	37
Lonepeak	Pinnacle Peak	230	38
Lonepeak	Sunnyslope	230	39
Lincoln Street	Ocotillo	230	40
Lincoln Street	West Phoenix	230	41
Mazatzal	Preacher Canyon	345	42
Mazatzal	Pinnacle Peak	345	43
Meadowbrook	Country Club	230	44
Meadowbrook	Sunnyslope	230	45

Simulation			Page
From Bus (Fault Location)	**To Bus**	**kV**	
Milligan	Saguaro	230	46
Moenkopi	Eldorado	500	47
Moenkopi	RME	500	48
Moenkopi	Yavapai	500	49
N.Gila	Imperial Valley	500	50
Navajo	Crystal	500	51
Navajo	Dugas	500	52
Navajo	RME	500	53
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Perkins	Mead	500	55
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Palo Verde	Rudd	500	57
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Pinnacle Peak	Raceway	500	61
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Red Hawk	Hassayampa	500	63
RME	FCW	500	64
Rudd	Liberty	230	65
Rudd	Palm Valley	230	66
Raceway	Westwing	500	67
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Saguaro	Tatmomli	230	69
Santa Rosa	Desert Basin	230	70
Santa Rosa	Tatmomli	230	71
Surprise	Westwing	230	72
Sundance	Pinal Central	230	73
Surprise	El Sol	230	74
TS4	Palm Valley	230	75
TS6	Pinnacle Peak	230	76
West Phoenix	Rudd	230	77
West Phoenix	White Tanks	230	78
White Tanks	El Sol	230	79
White Tanks	Rudd	230	80
Yavapai	Willow Lake	230	81
Yavapai	Westwing	500	82

Simulation	Page
Transformer Outages (Fault on High Side)	
Cholla 500/345kV #1	83
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Cholla 345/230kV	85
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Four Corners 500/345kV #2	87
Four Corners 500/345kV #1	88
Gila River 500/230kV	89
N.Gila 500/230kV	90
Pinnacle Peak 345/230kV #1	91
Pinnacle Peak 345/230kV #2	92
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Saguaro West 500/115kV	97
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Simulation	Page
Generator Outages (Fault at Generator Terminals)	
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Four Corners 5CC	107
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Mesquite ST1	109
Navajo 2	110
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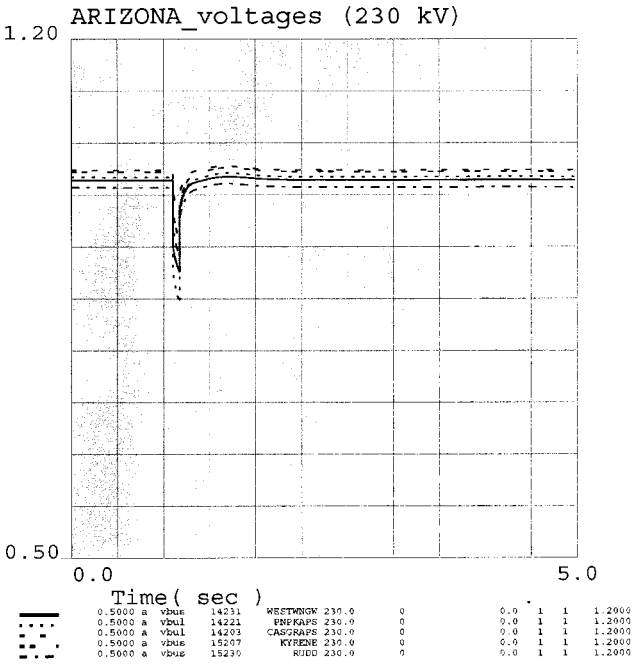
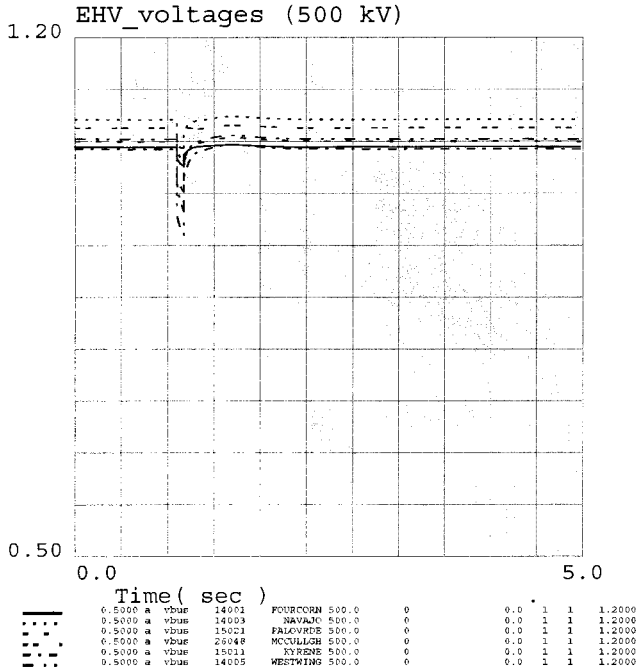
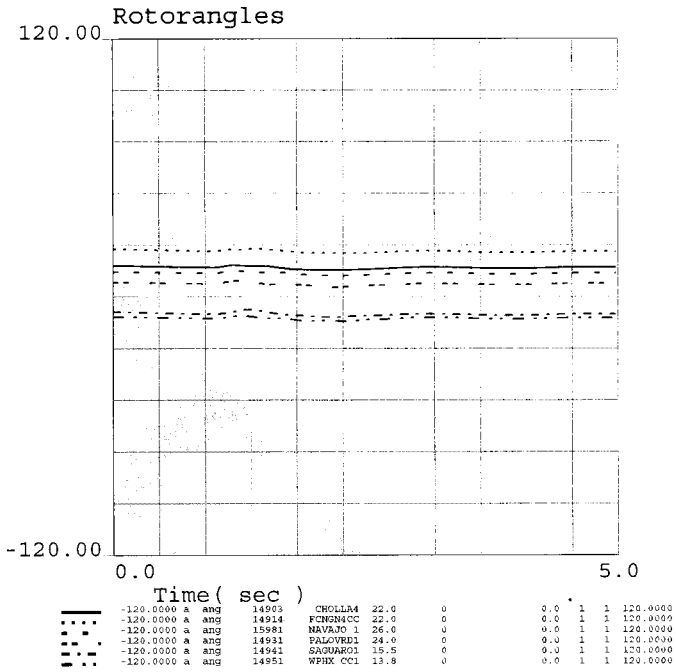
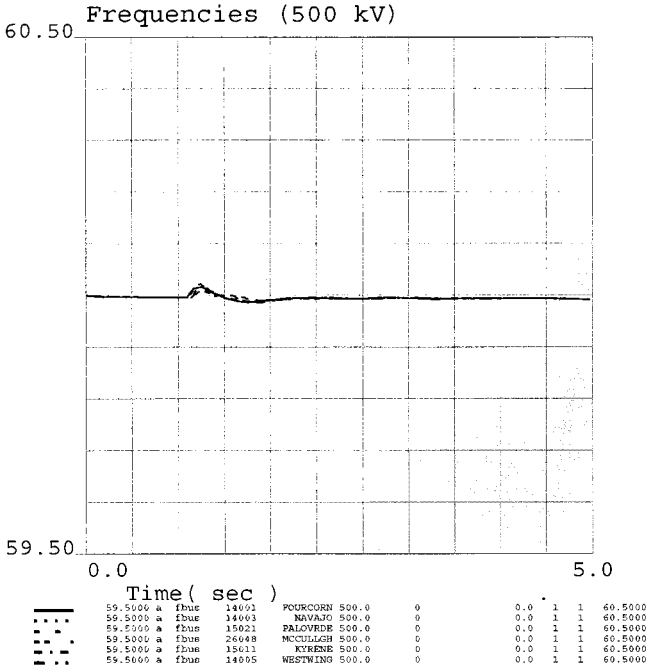
Redhawk CT2 & ST1	113
Saguaro CT3	114
Sundance G3 & G4	115
West Phoenix North 5CT2	116
West Phoenix South CC1	117
Yucca 1	118









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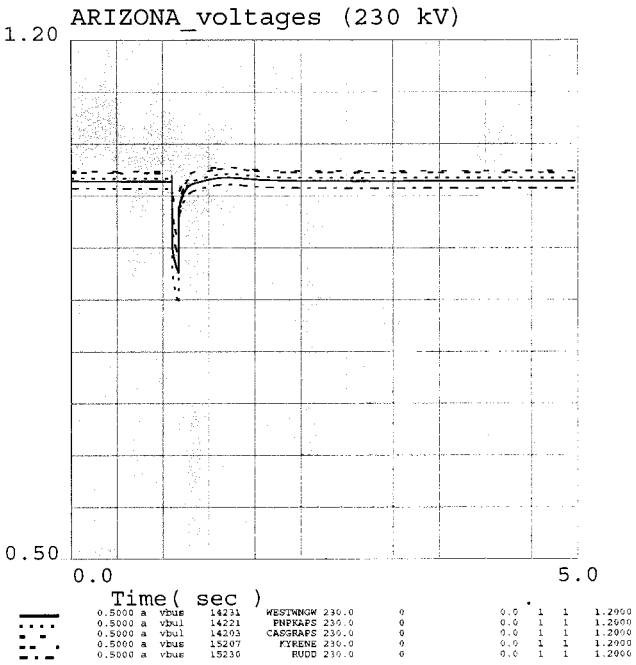

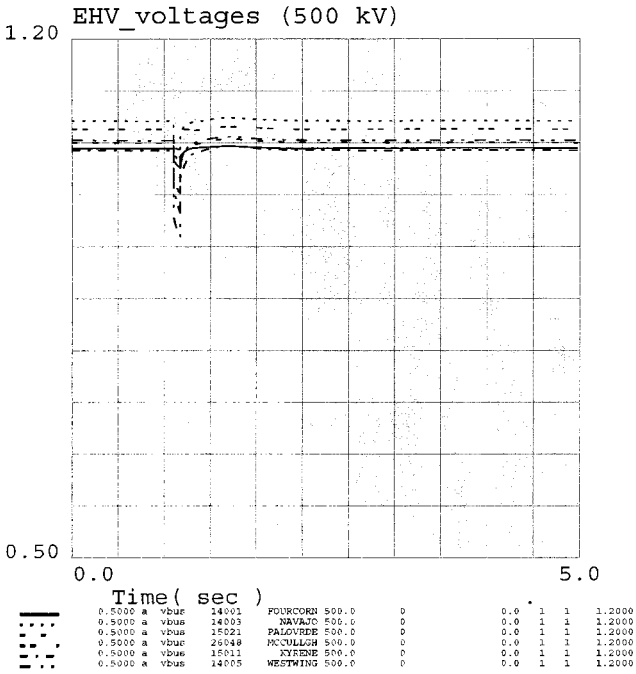

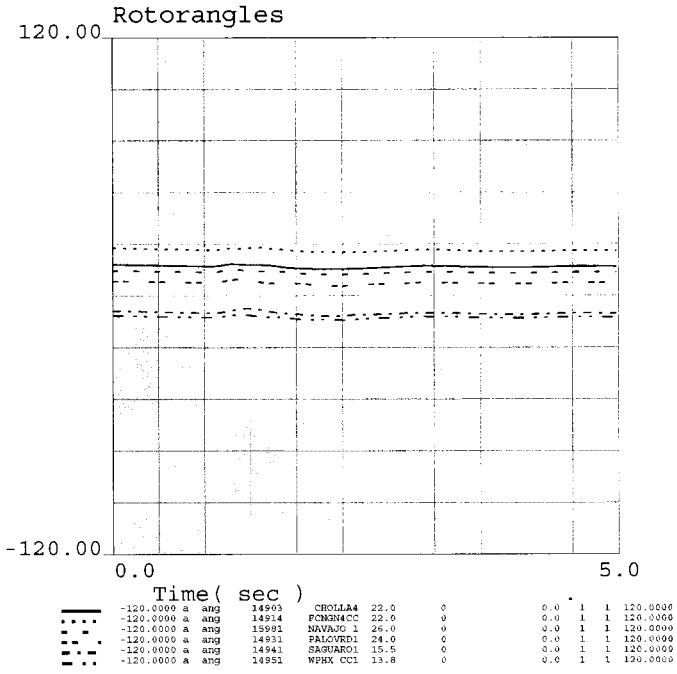

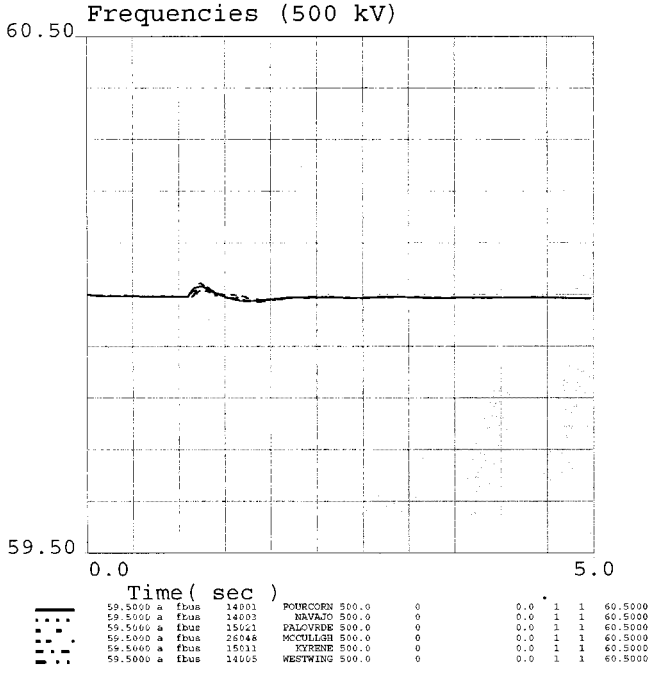

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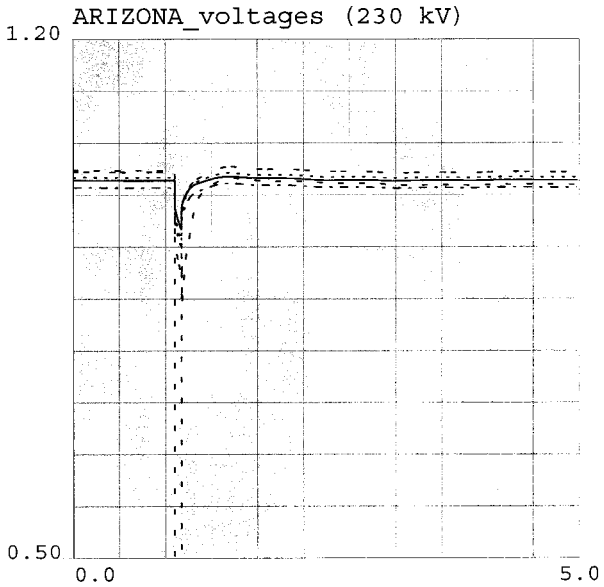

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0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
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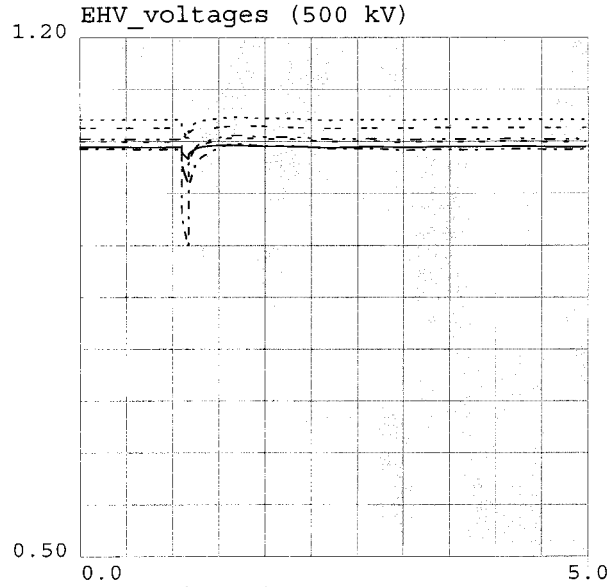

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0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
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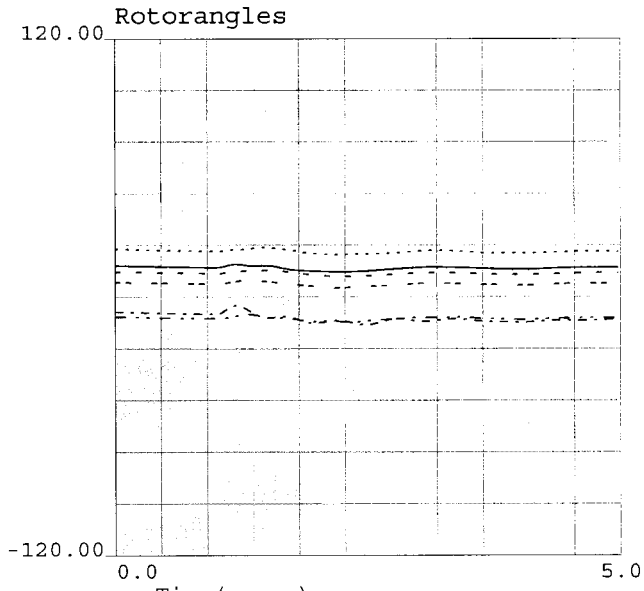

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-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
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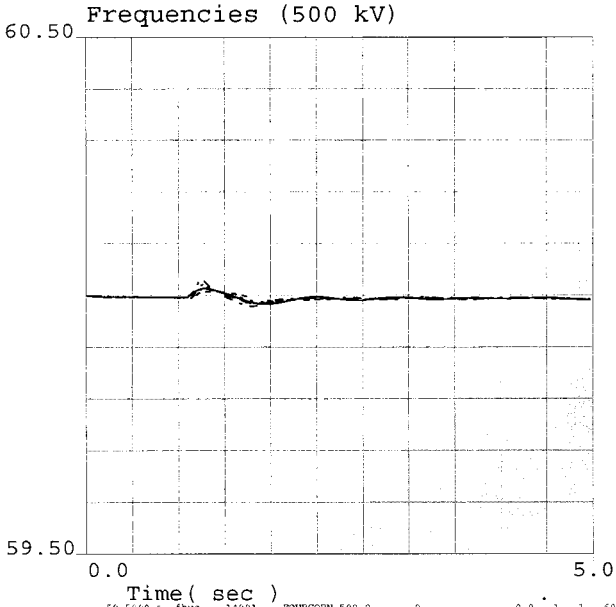

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59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
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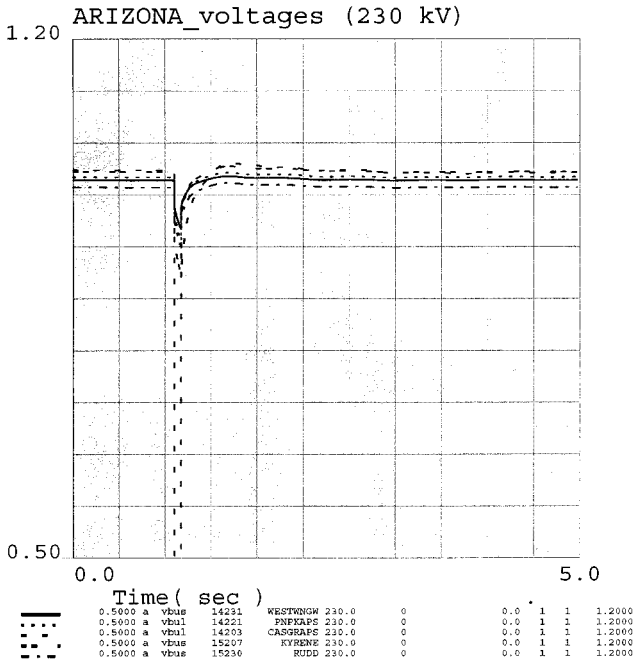

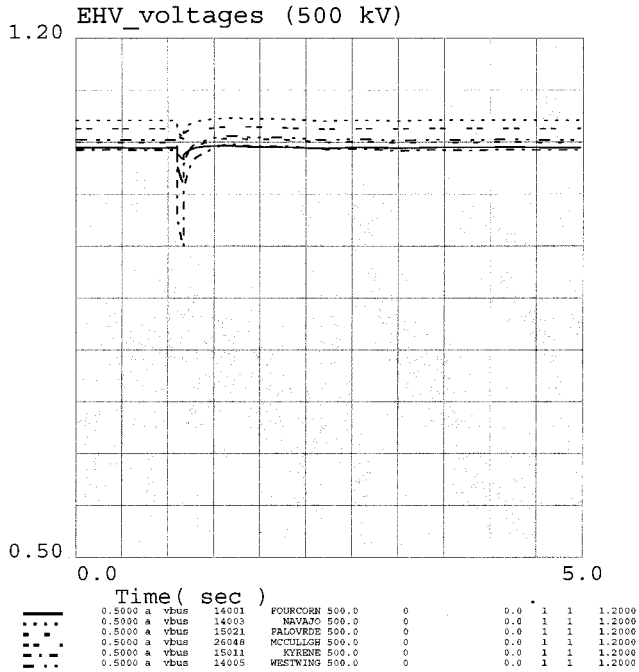

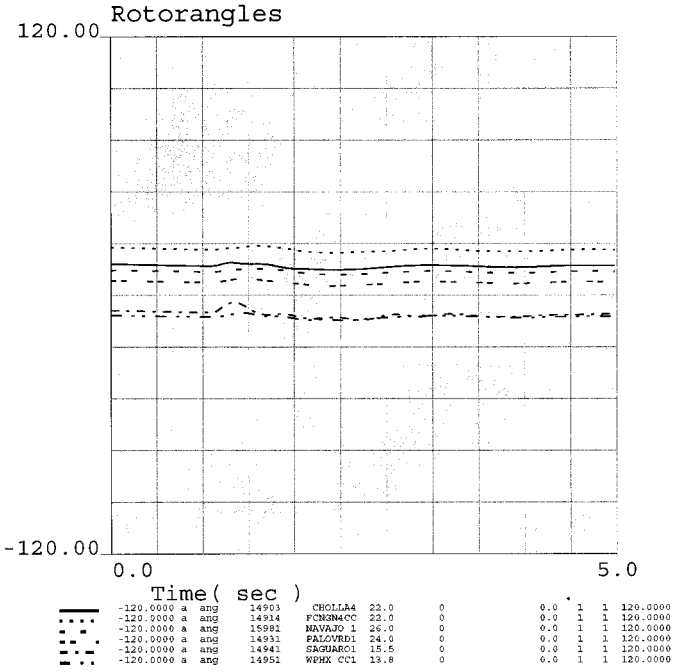

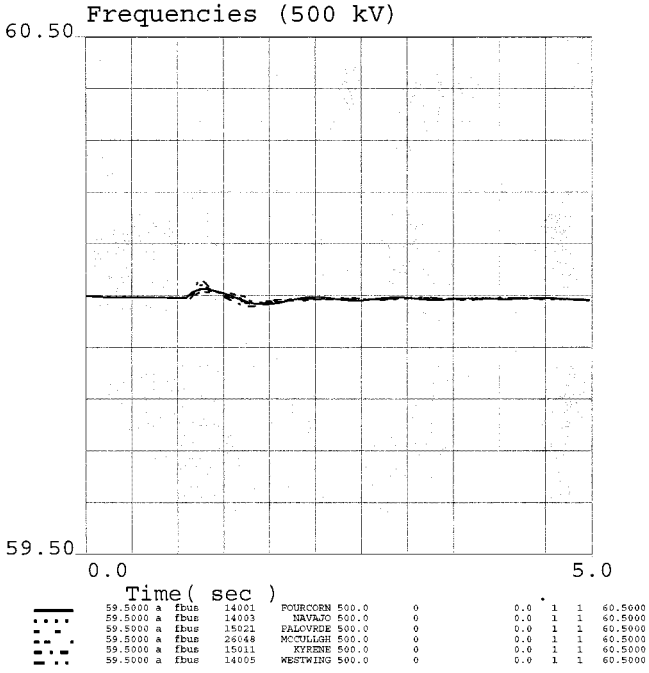

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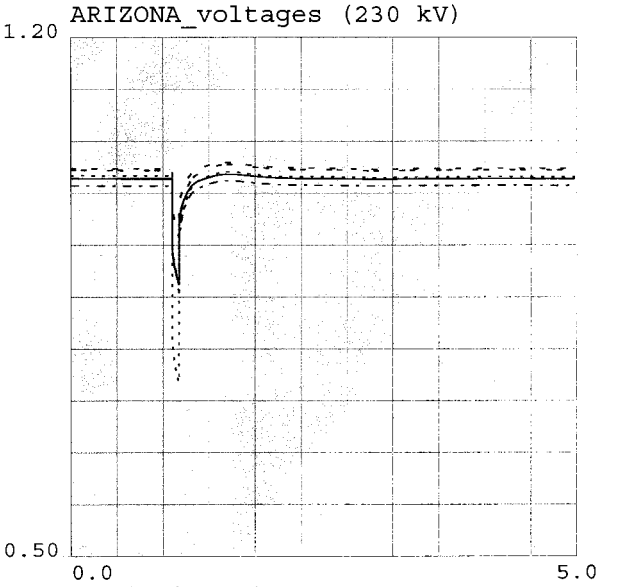

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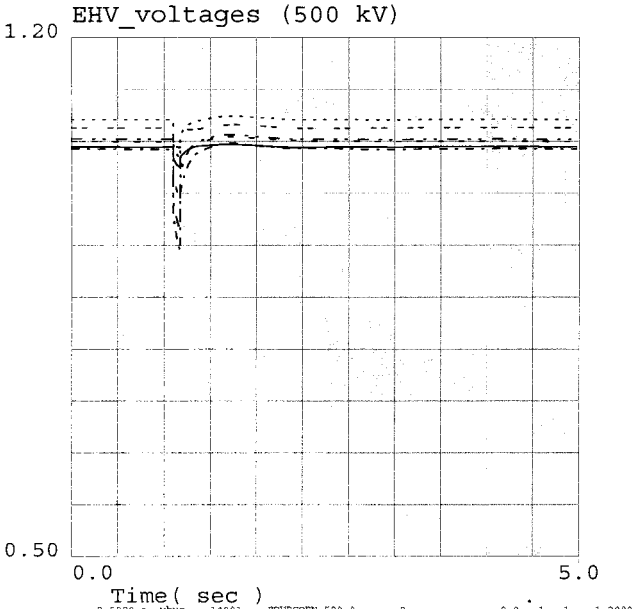

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0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
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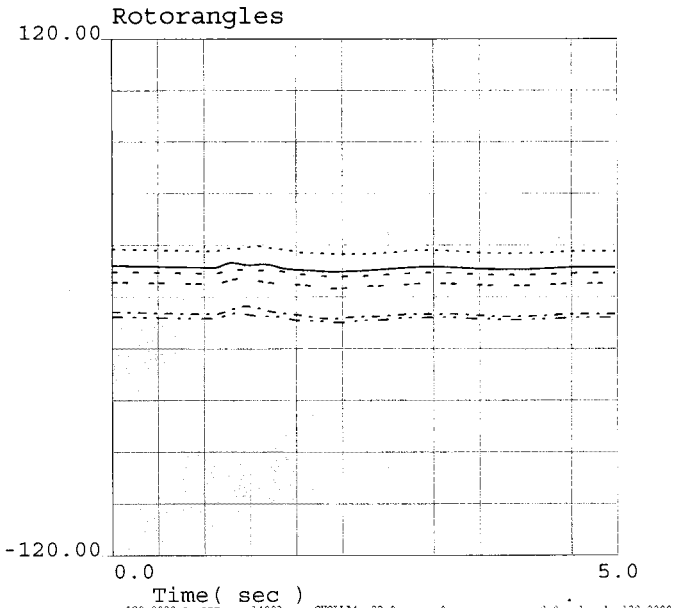

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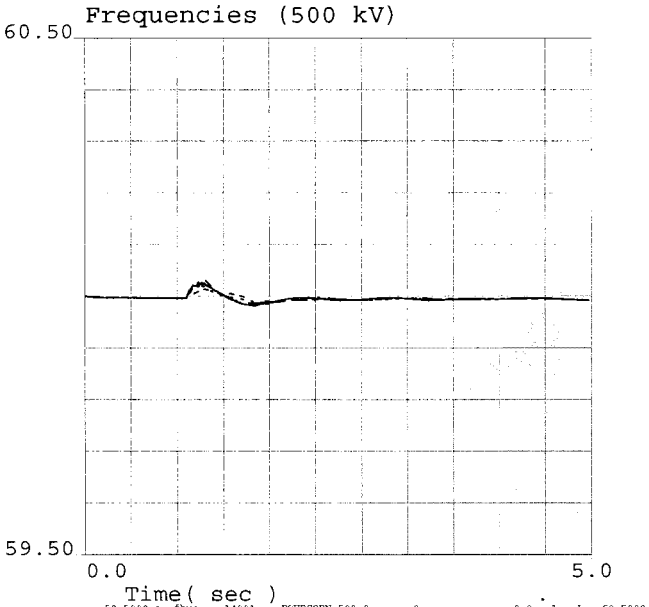

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59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
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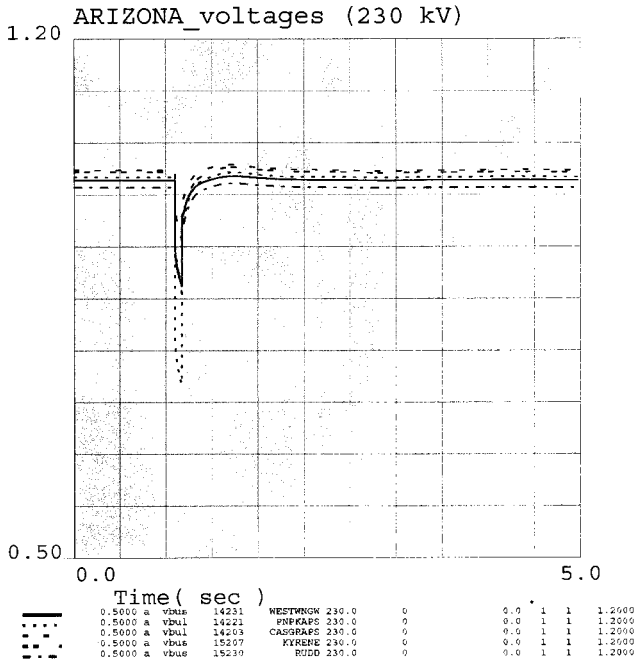

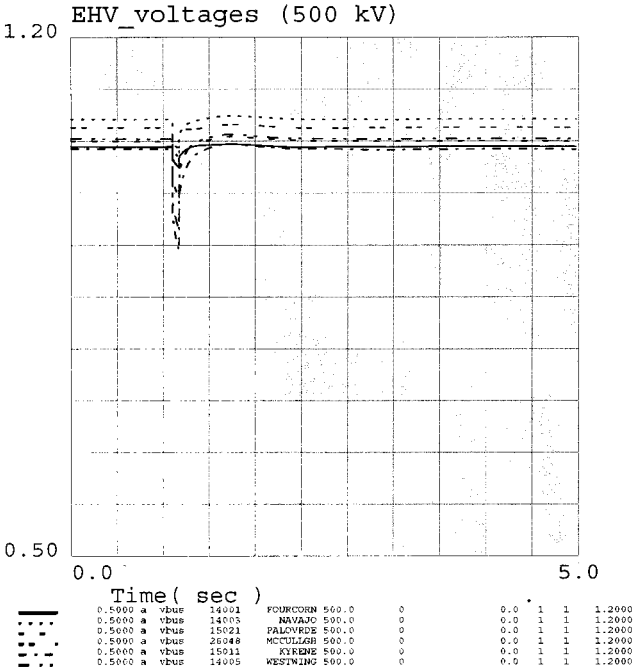

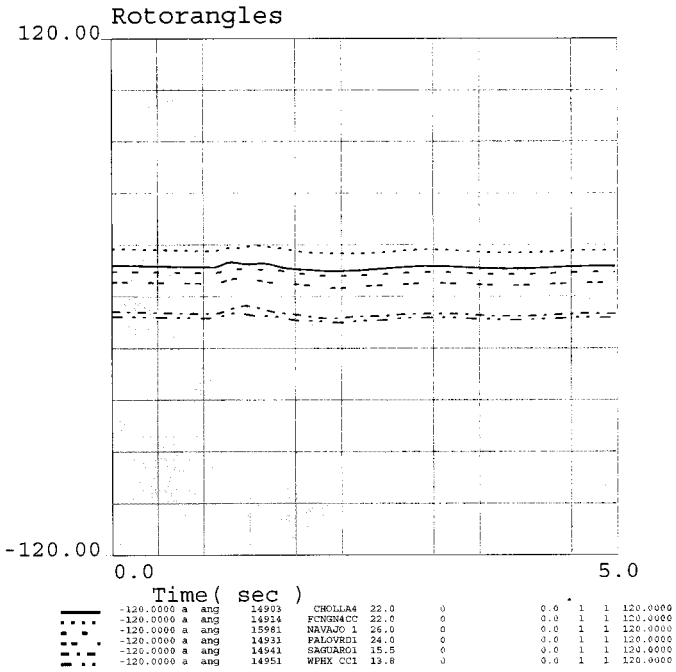

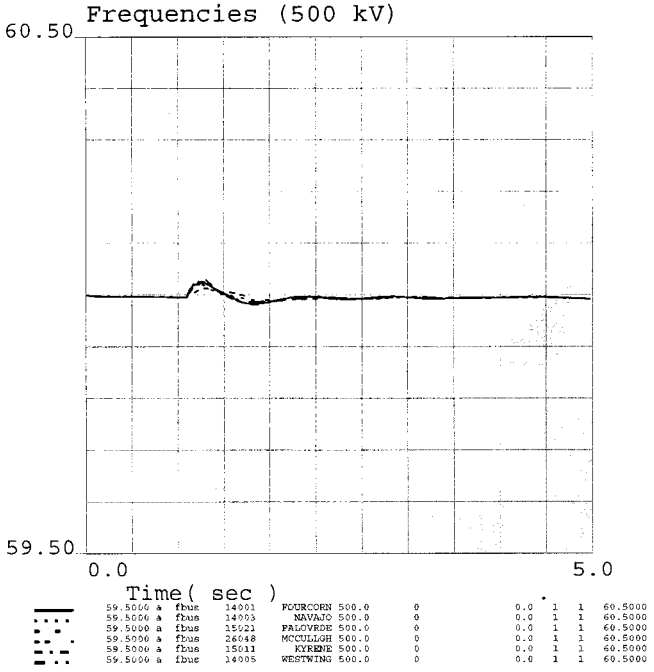

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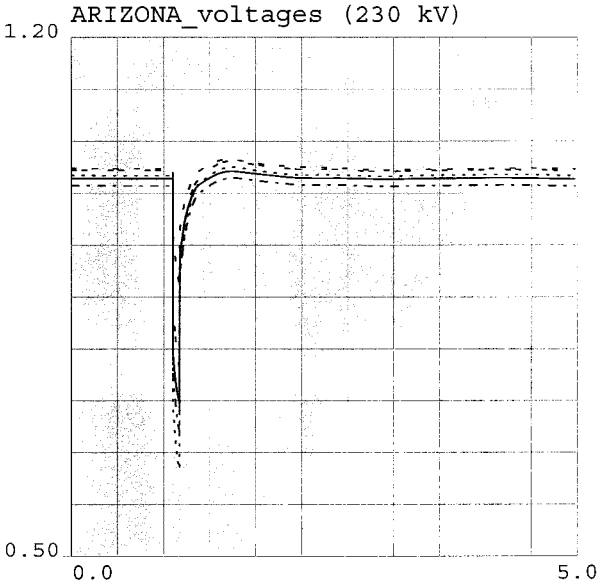
2009 APS Ten Year Plan
2013 Heavy Summer WECC/WestConnect Case



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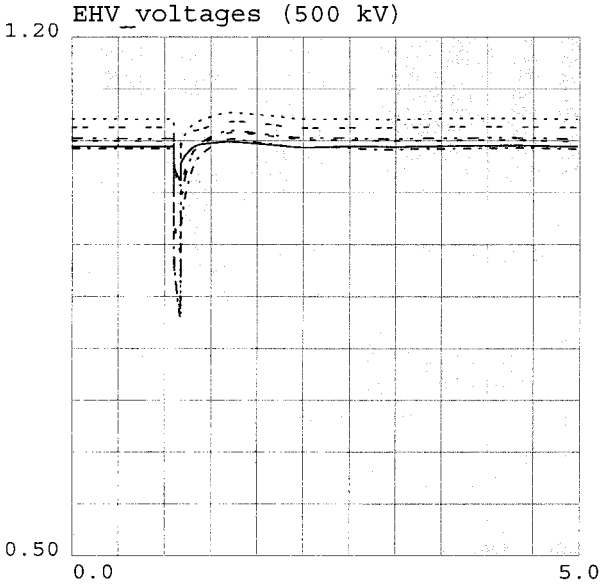

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0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
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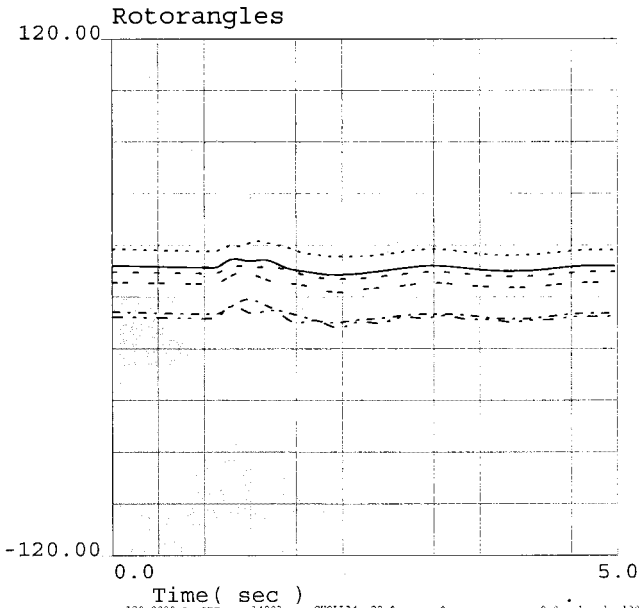

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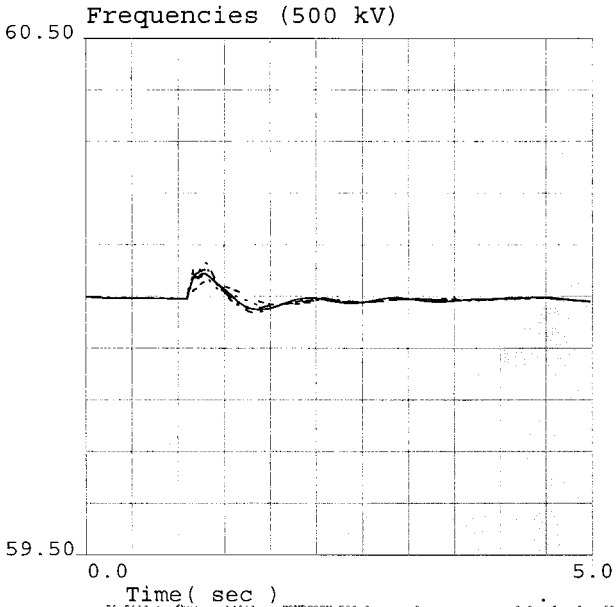

59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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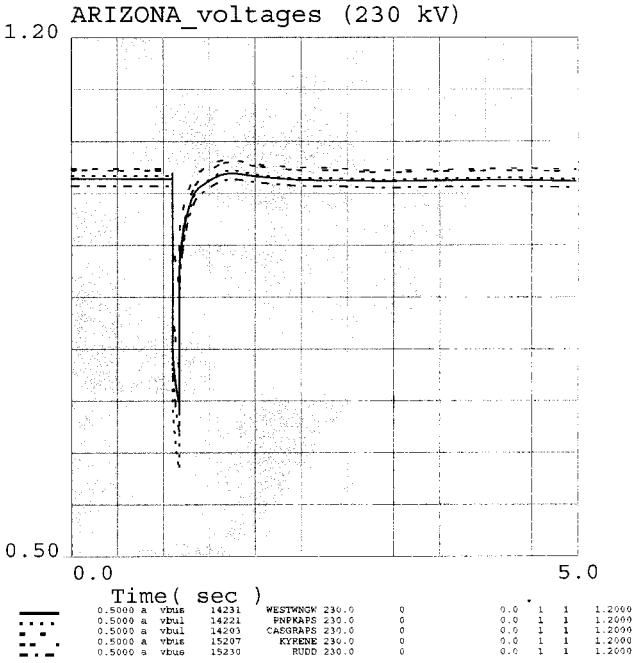

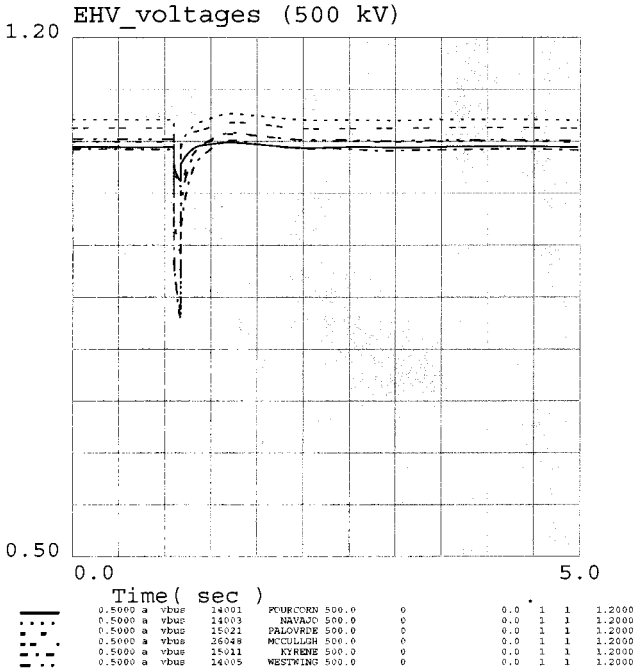

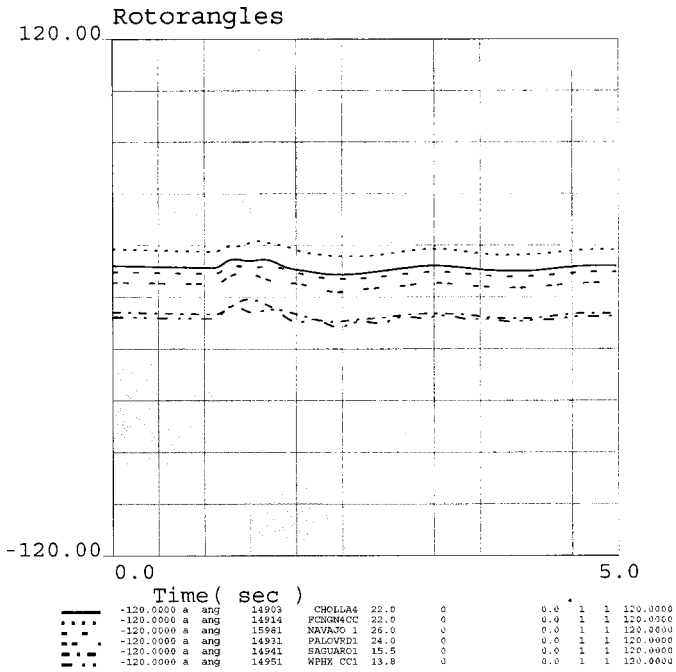

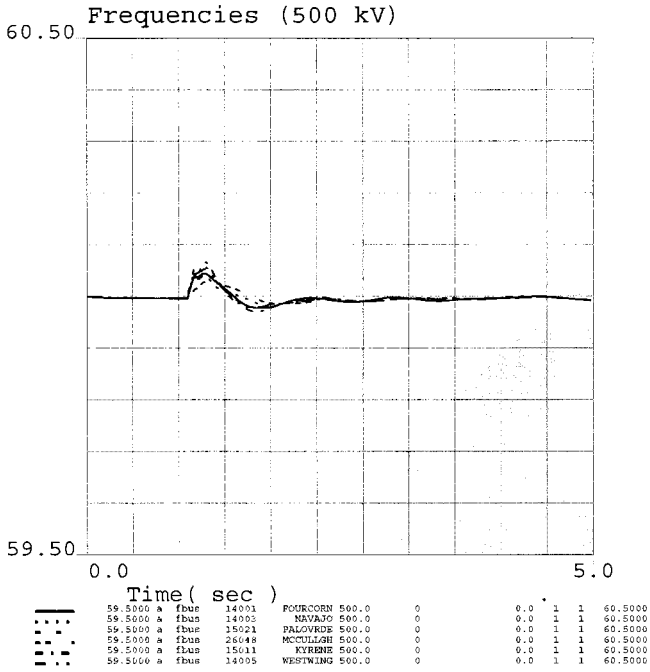

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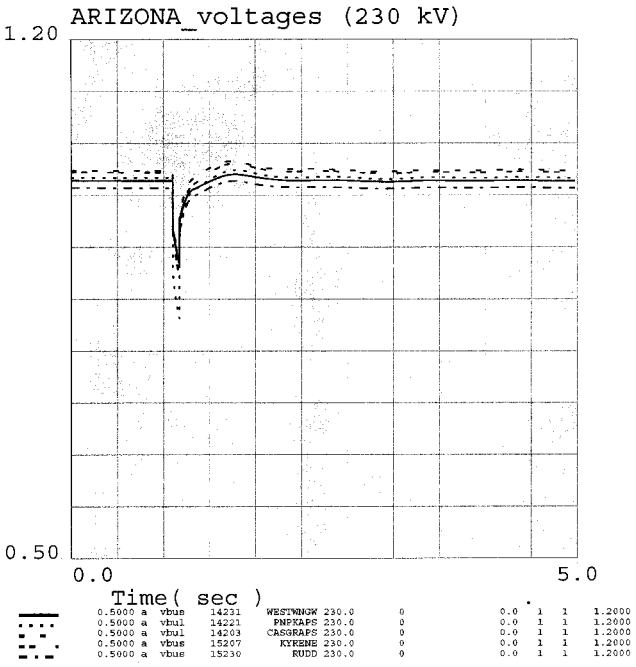

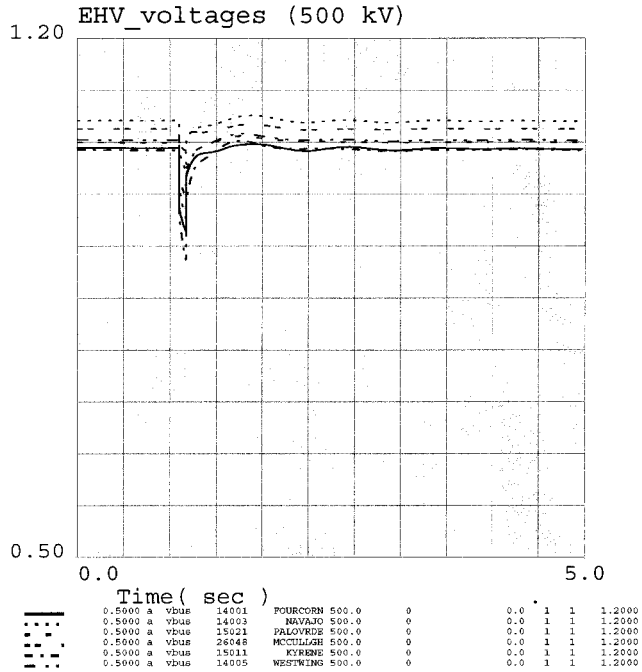

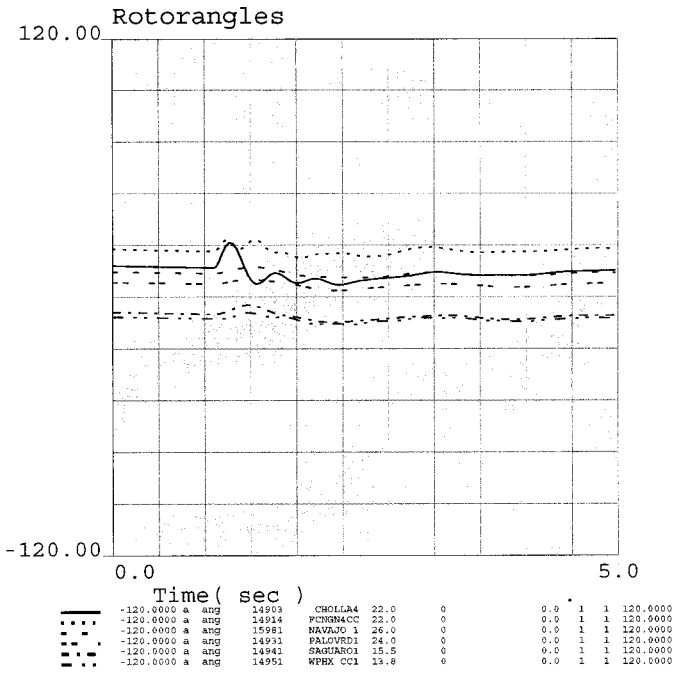

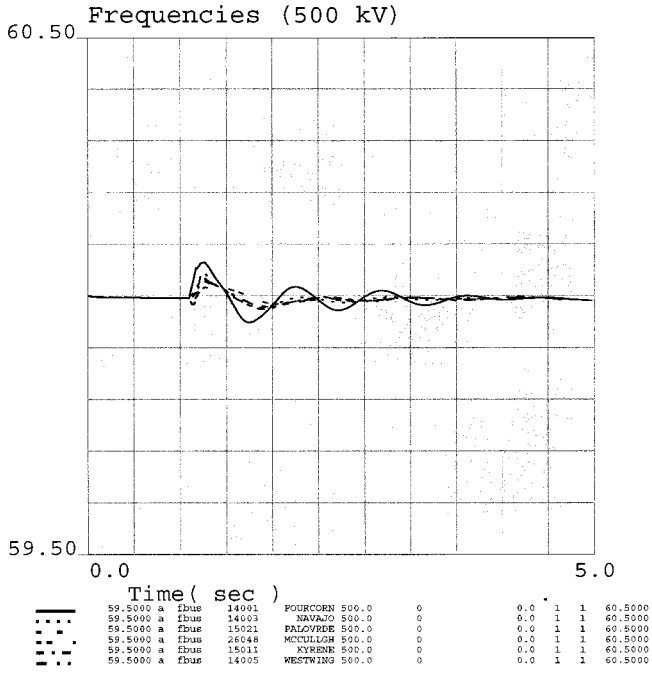

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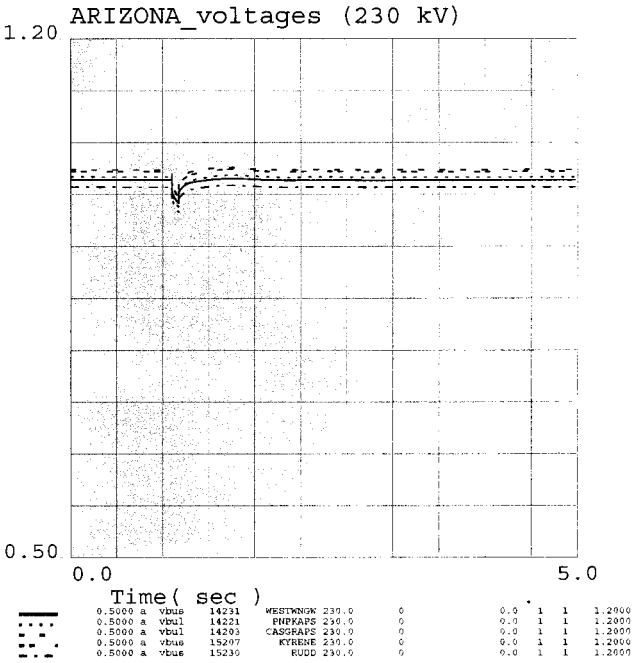

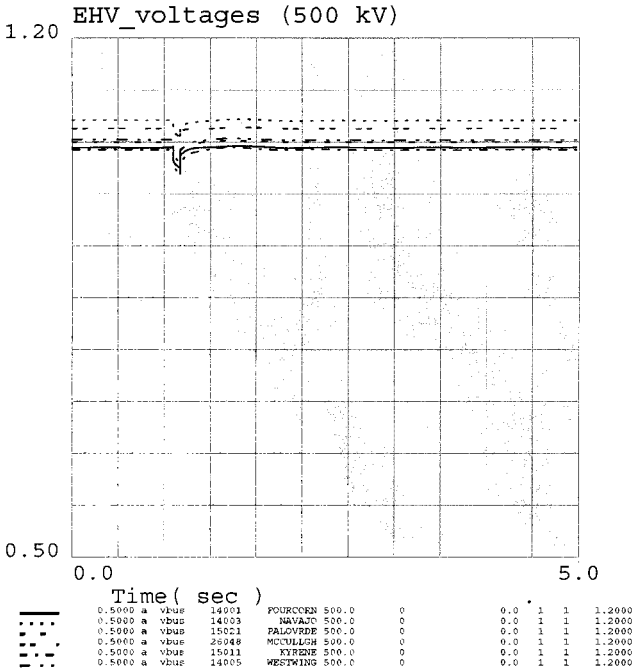

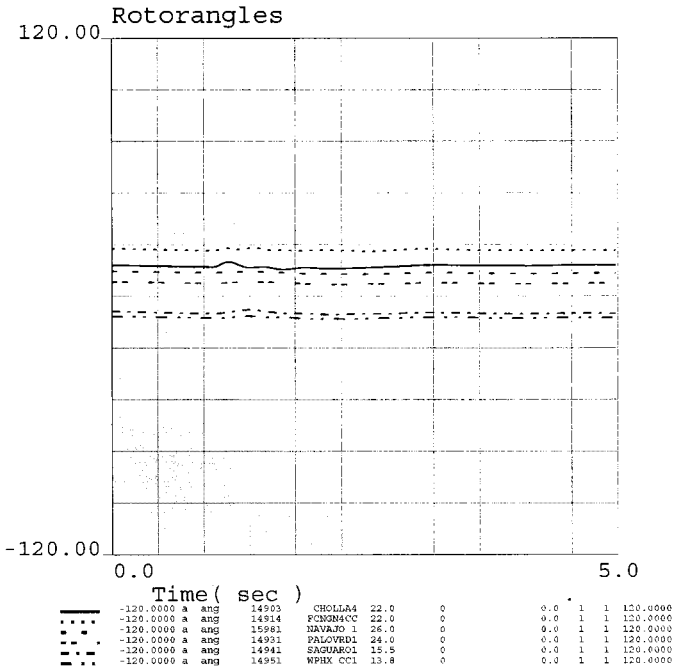

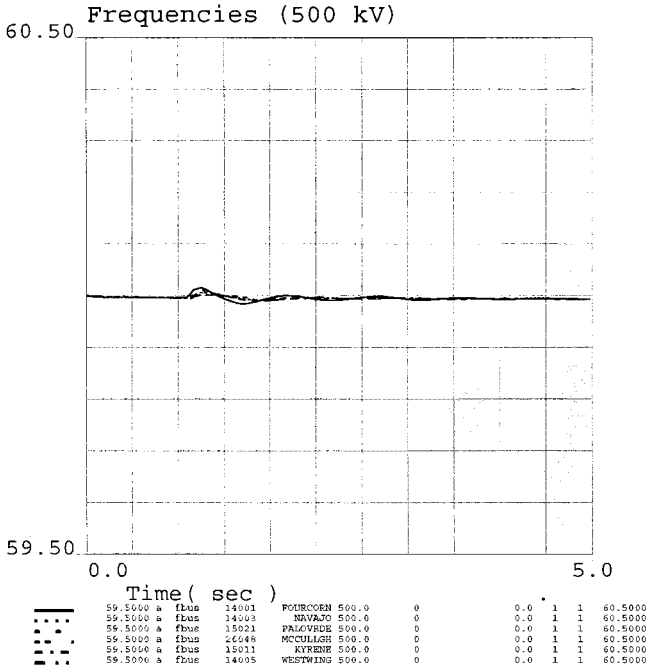

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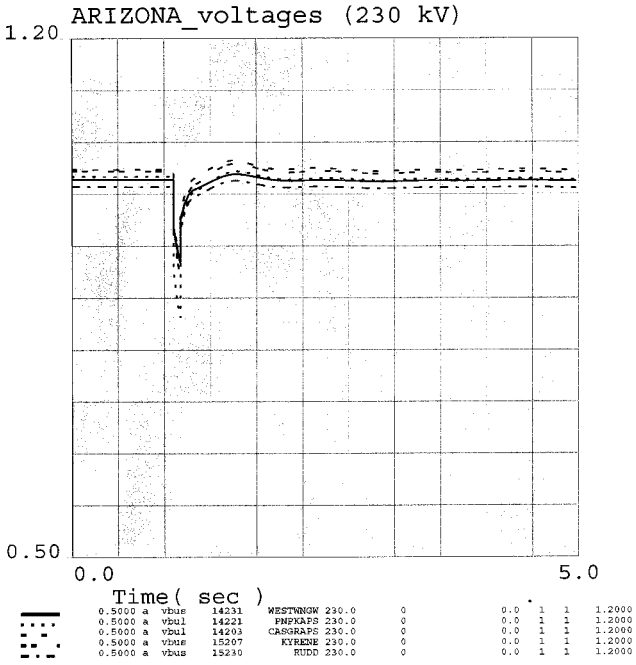

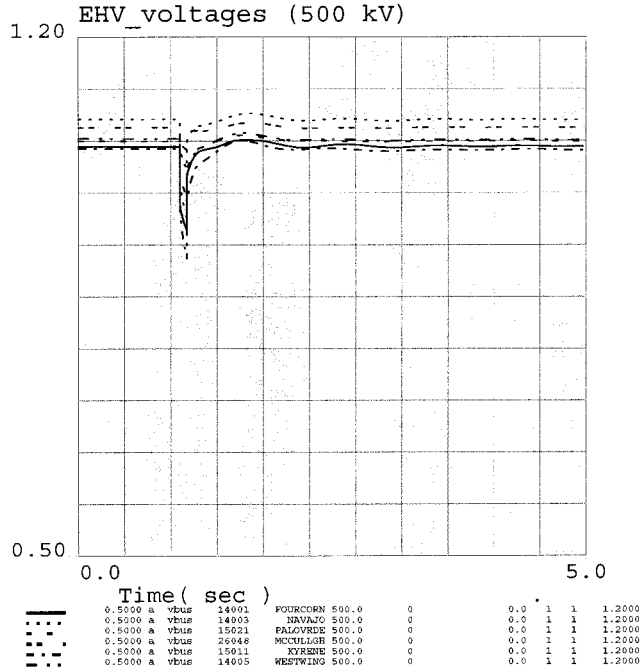

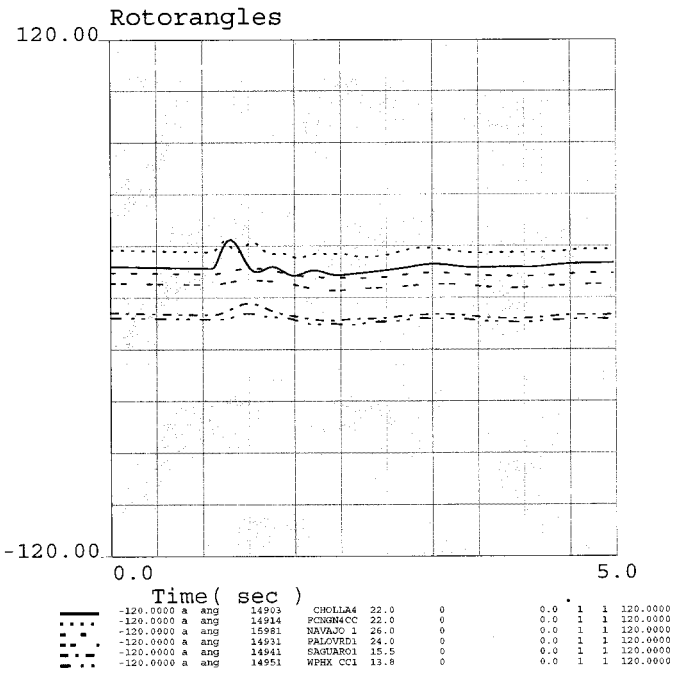

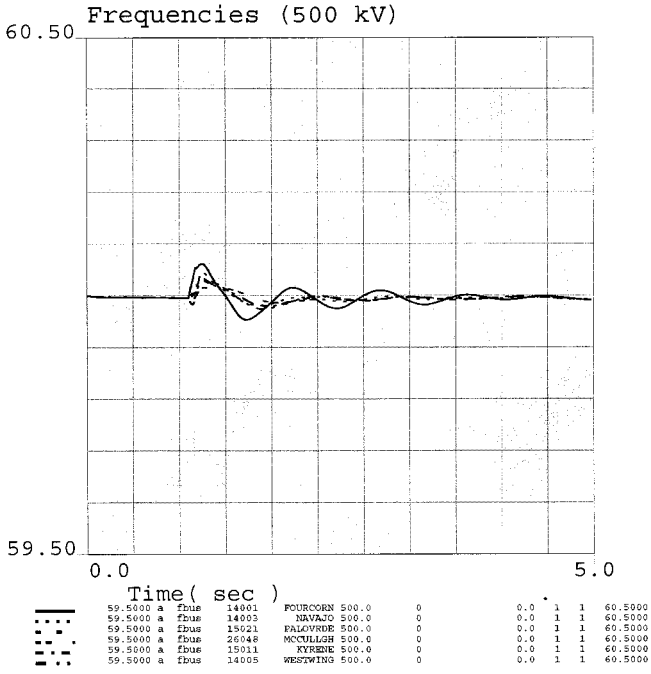

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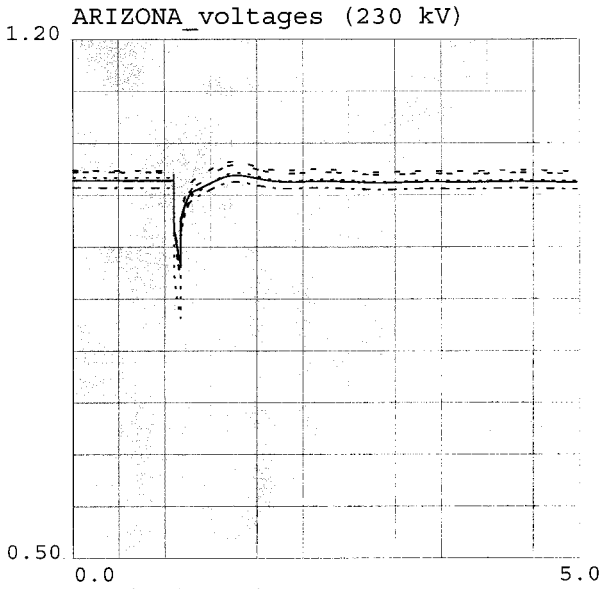
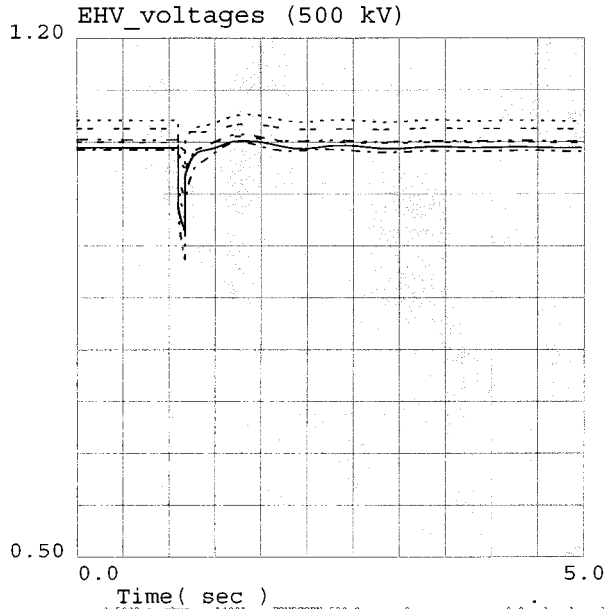
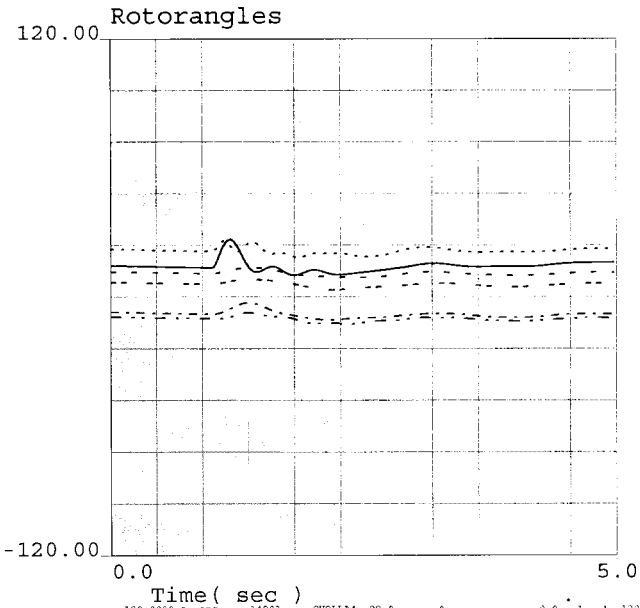


0.5000	a	vbus	14231	WESTWNGK	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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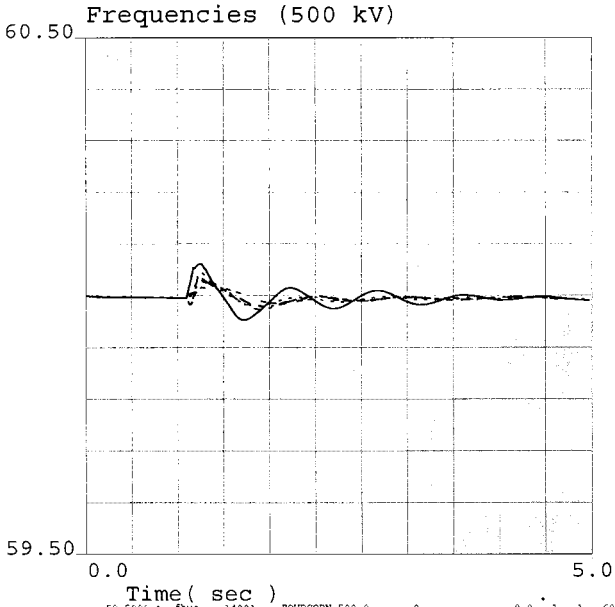

59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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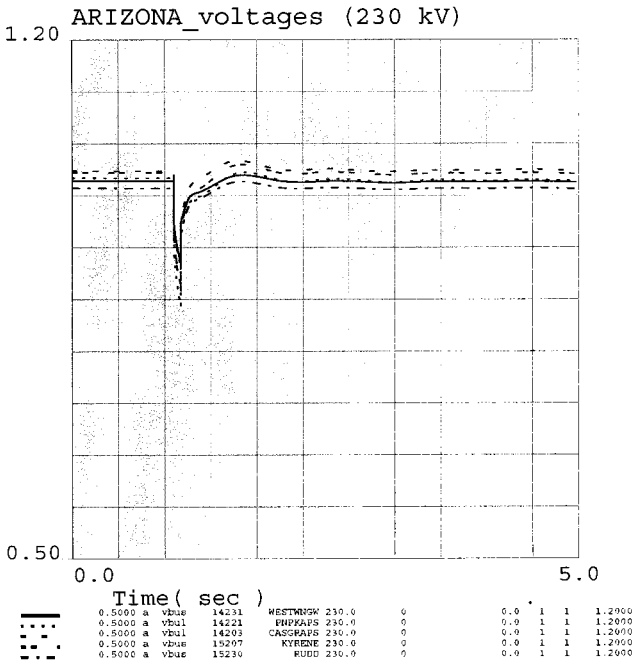

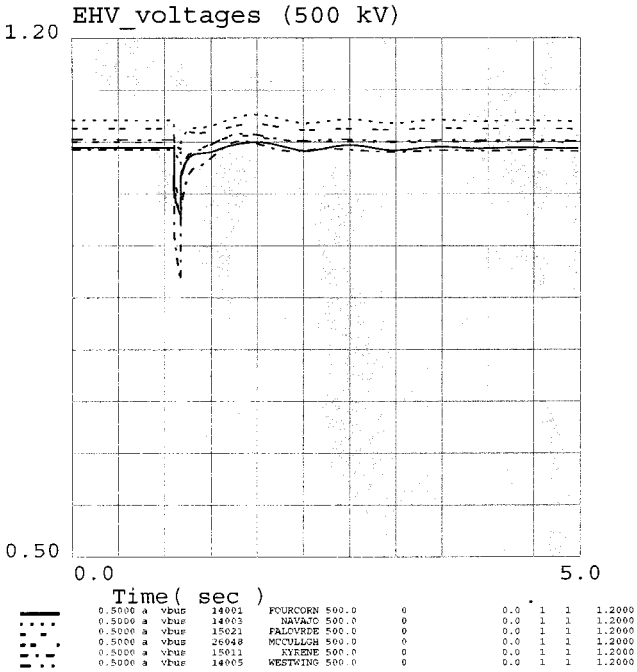

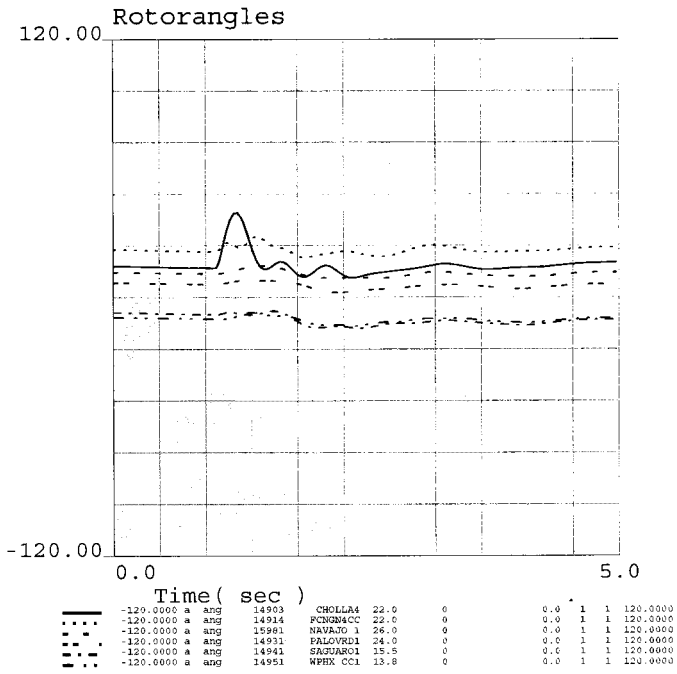

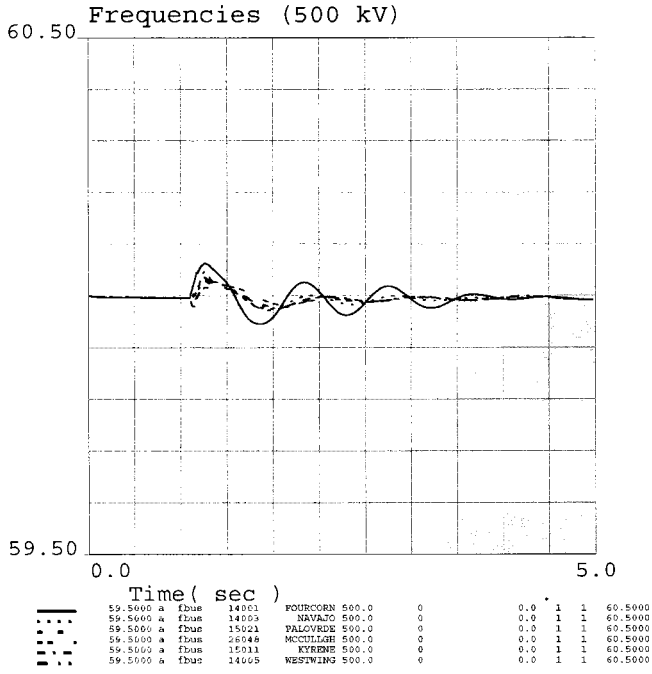

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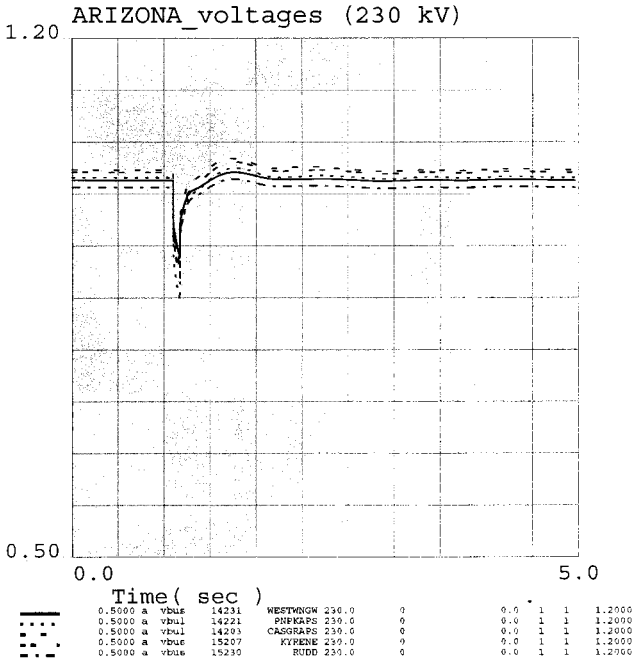

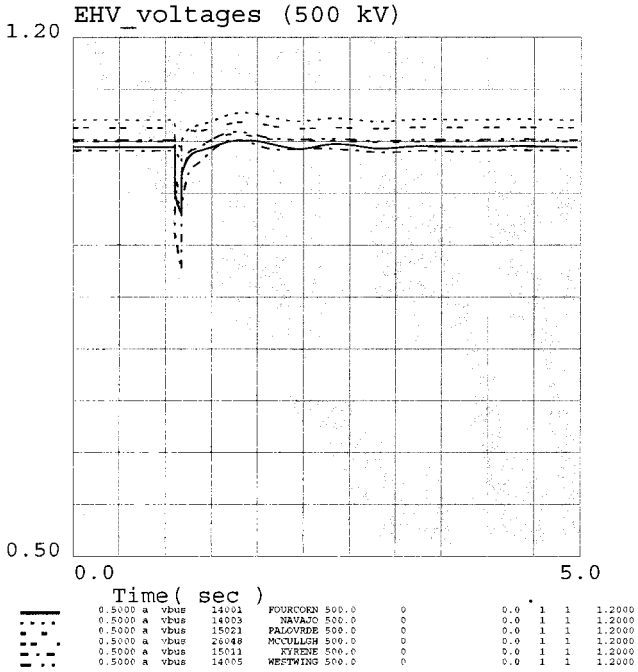

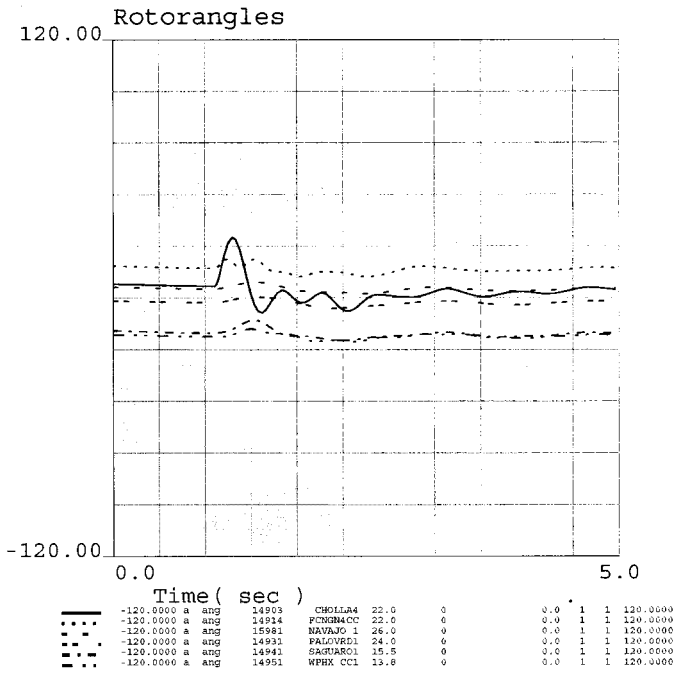

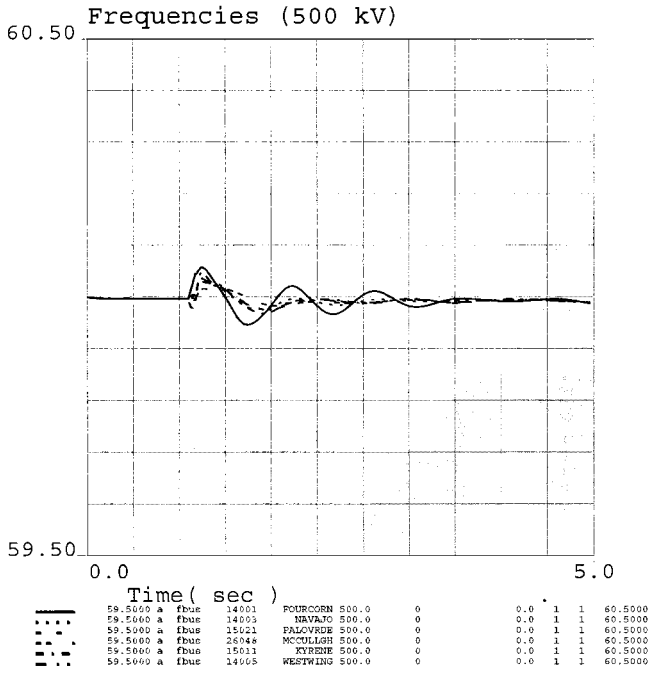

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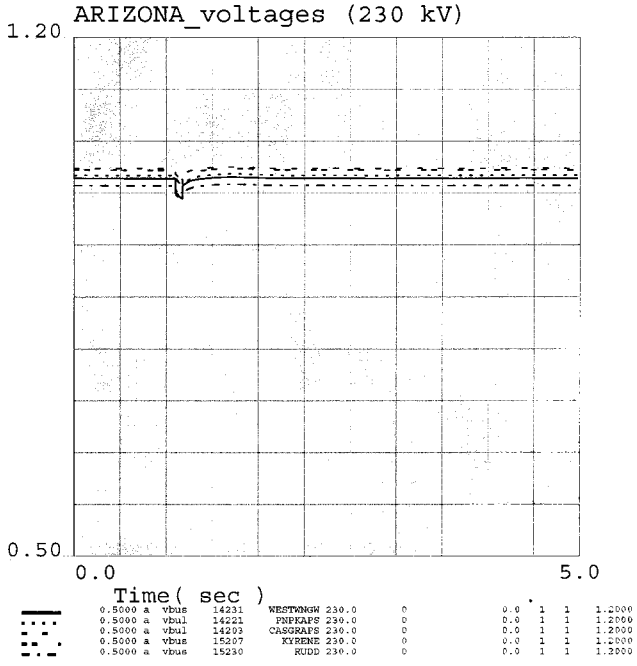

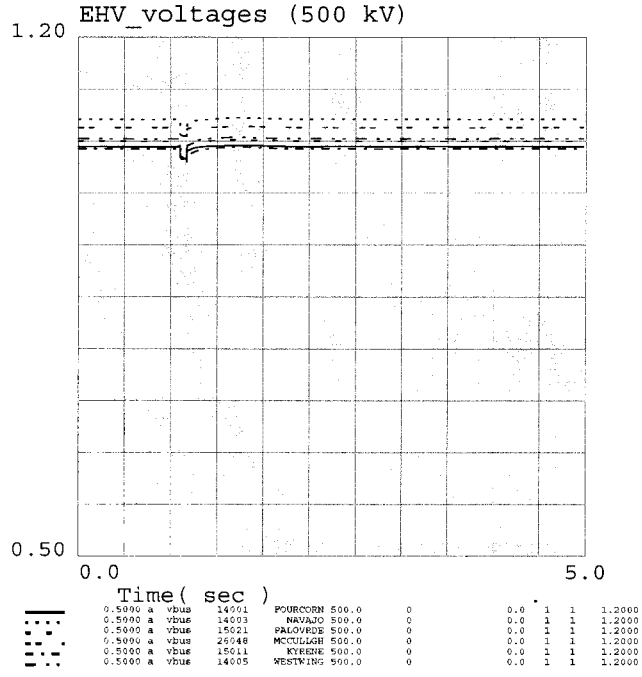

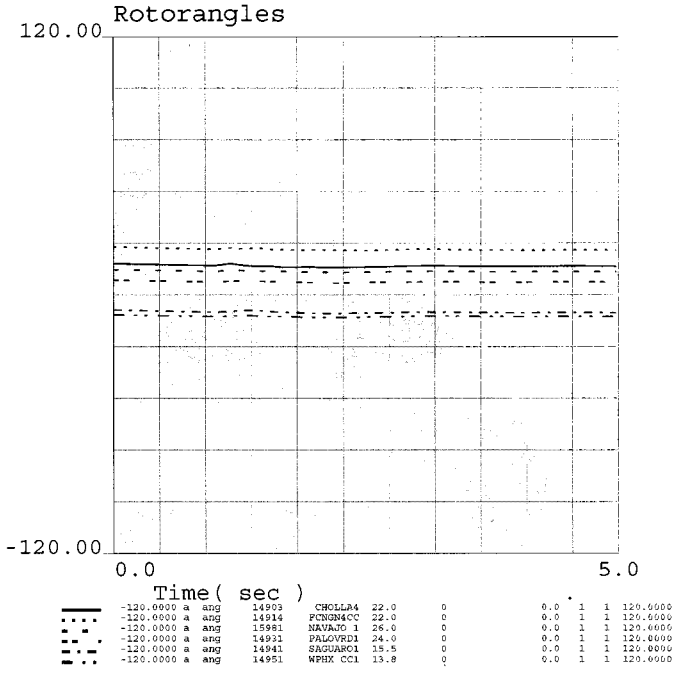

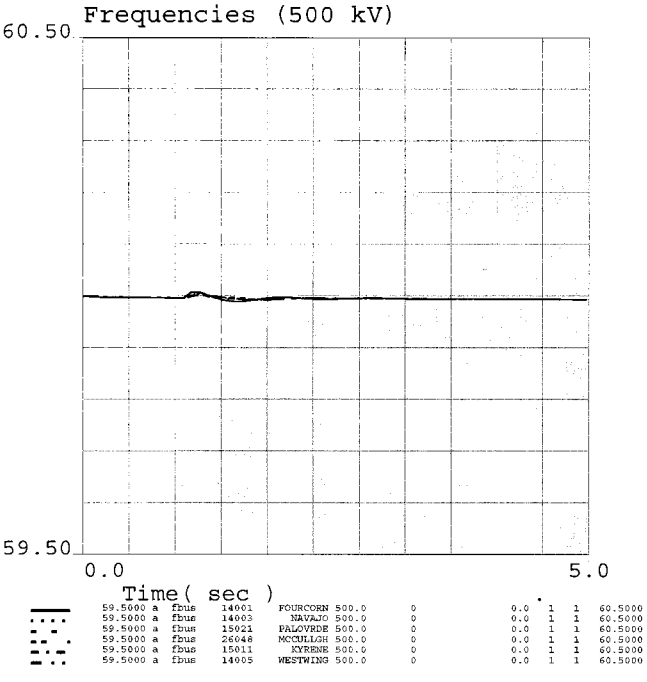

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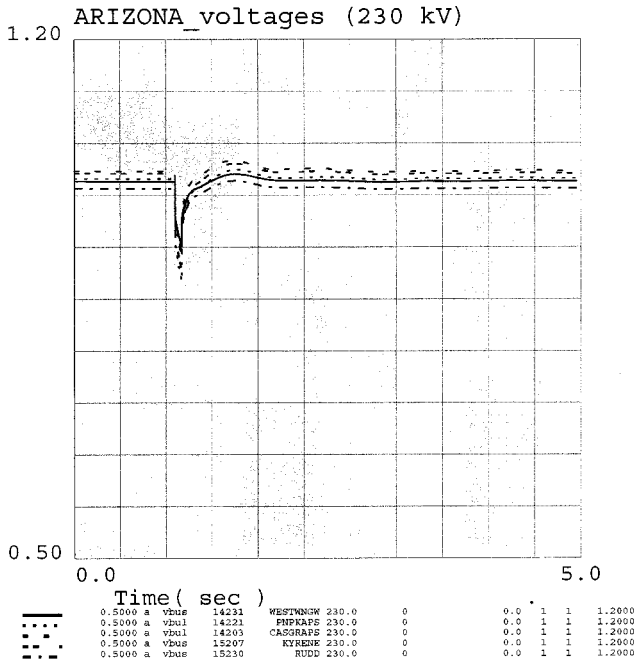

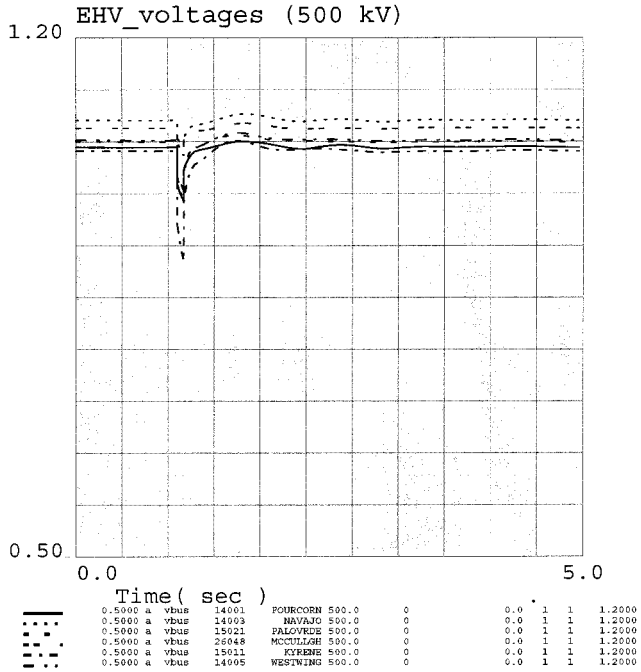

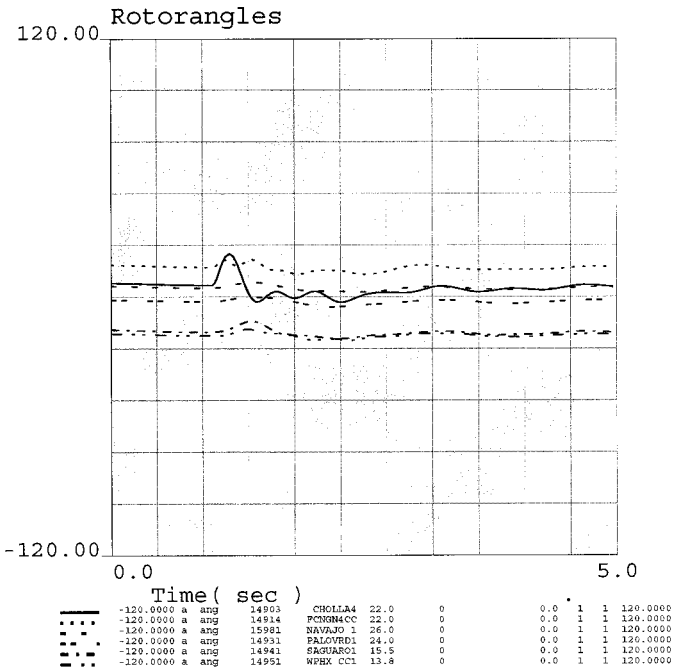

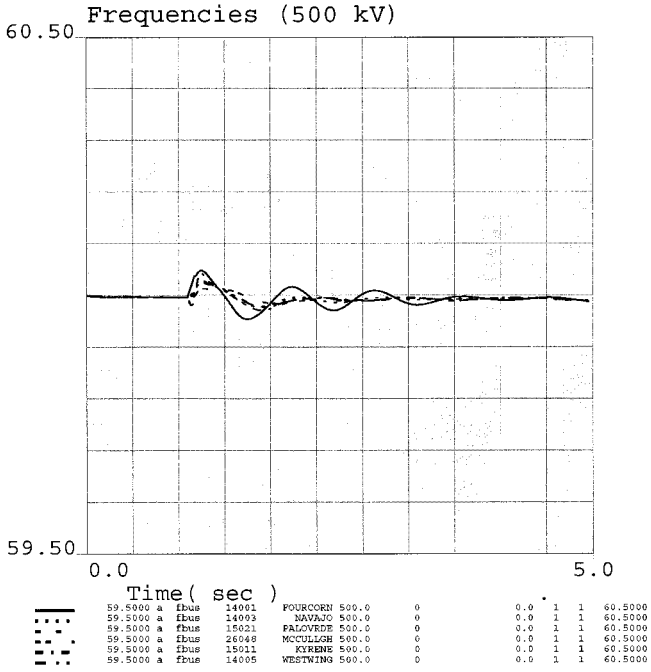

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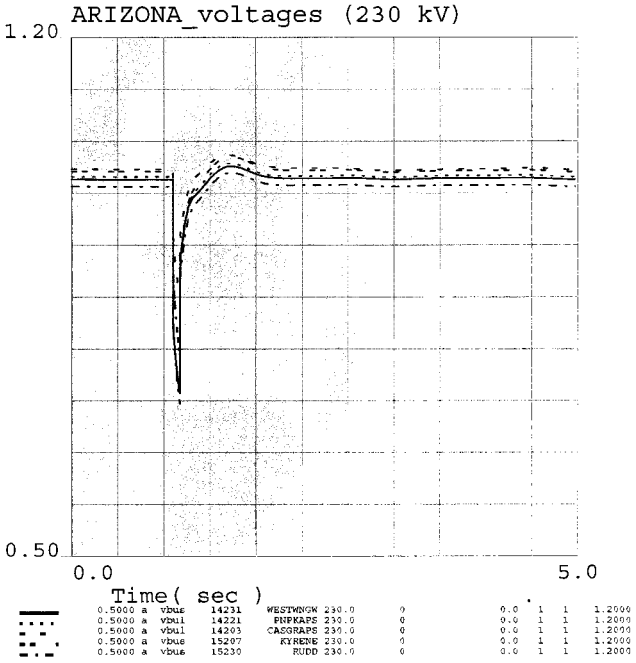

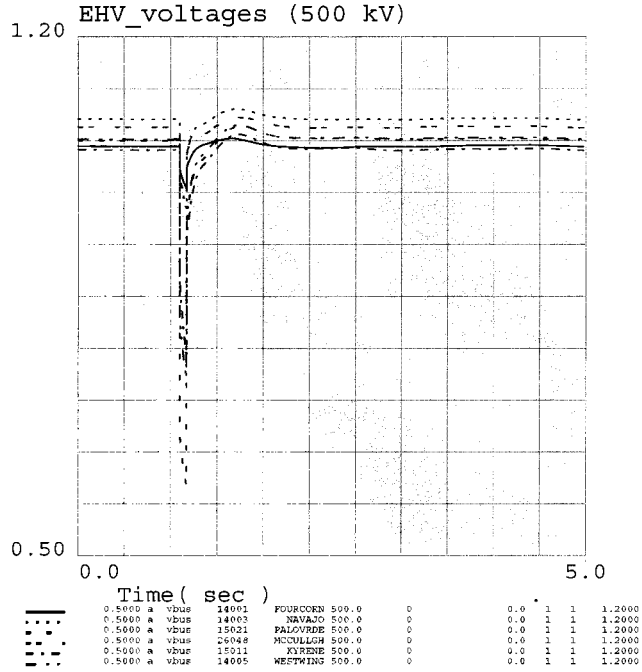

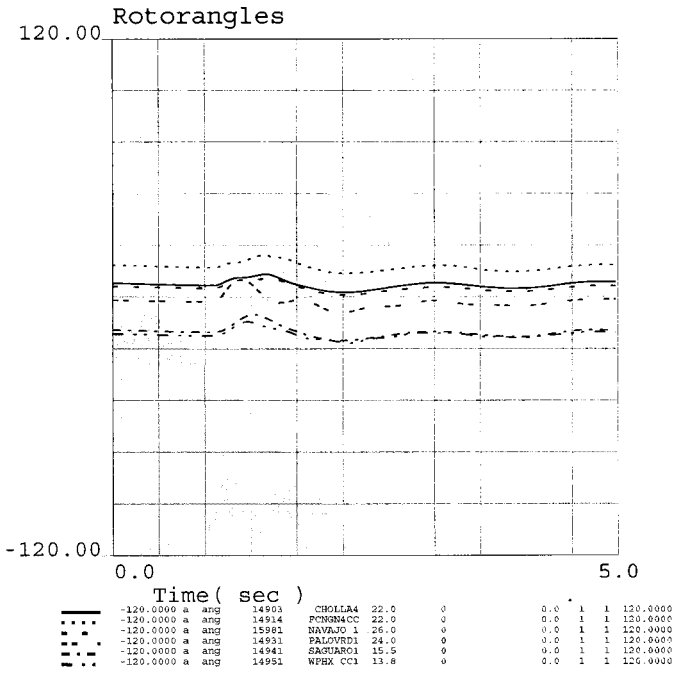

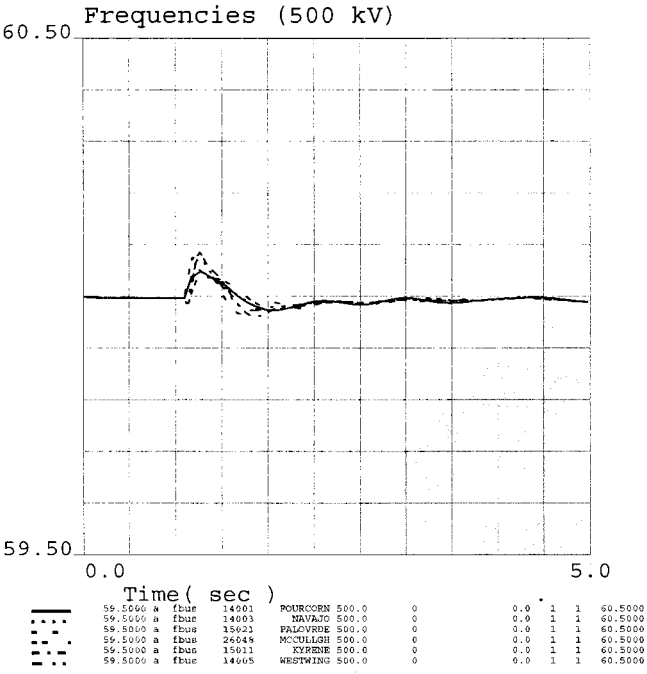

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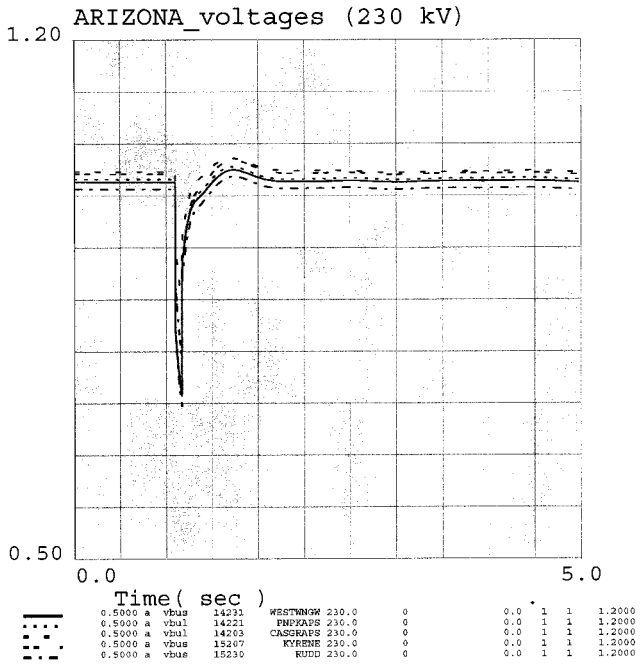

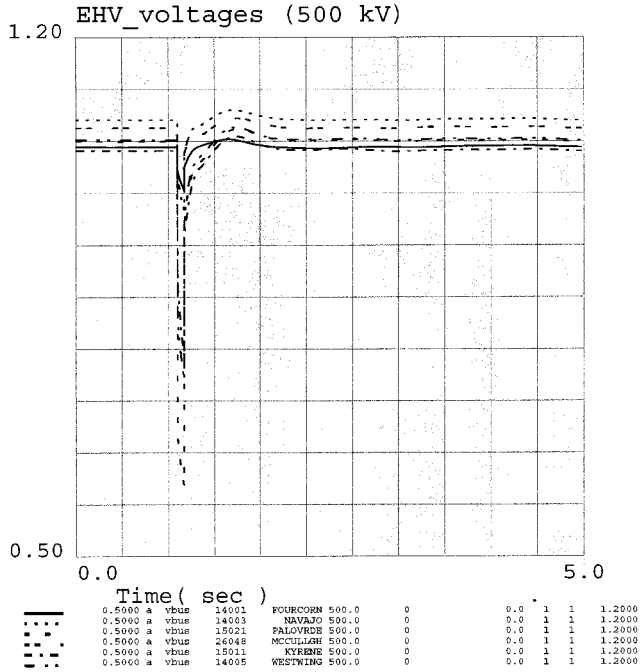

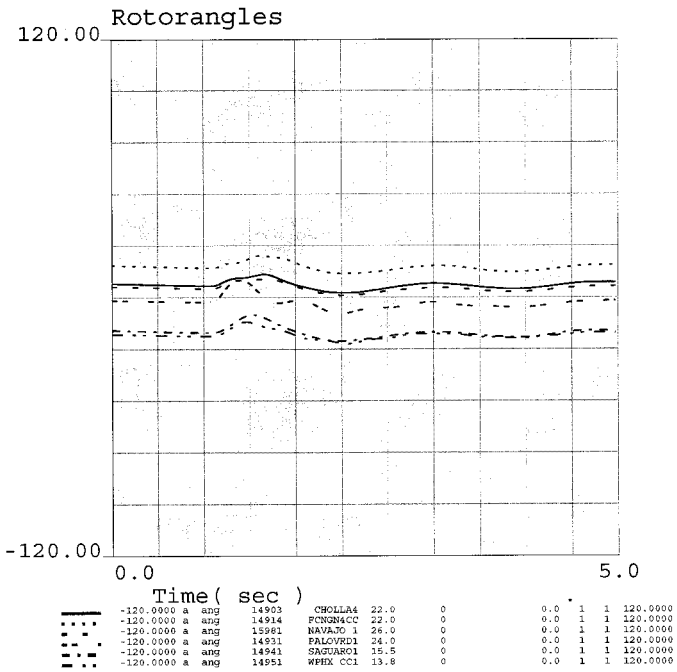

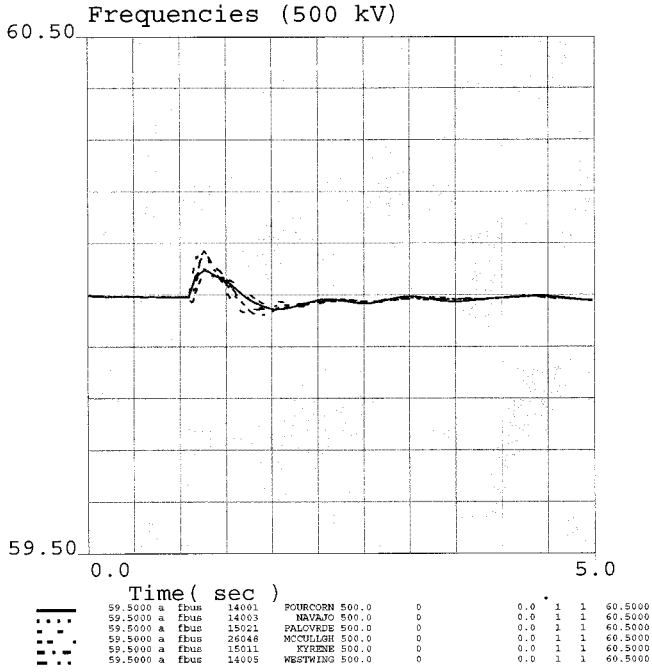

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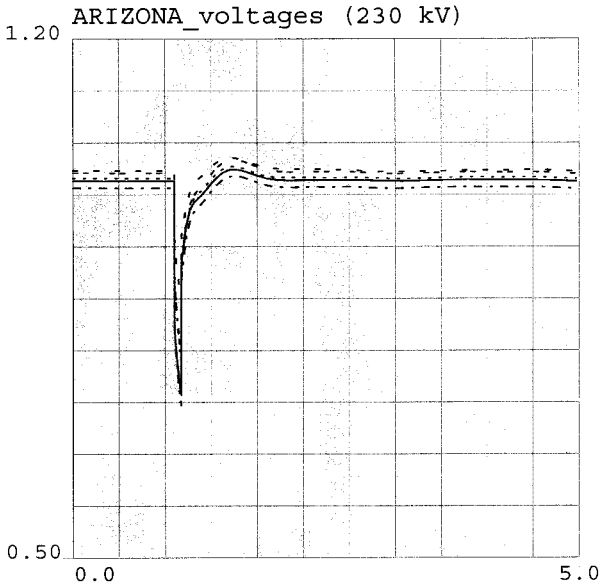
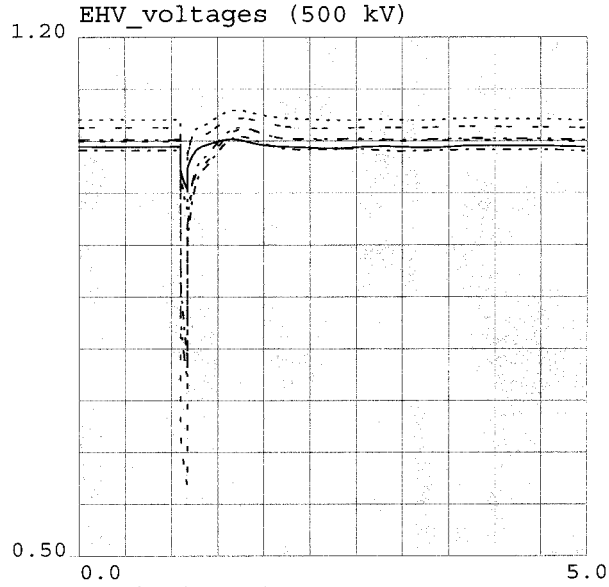
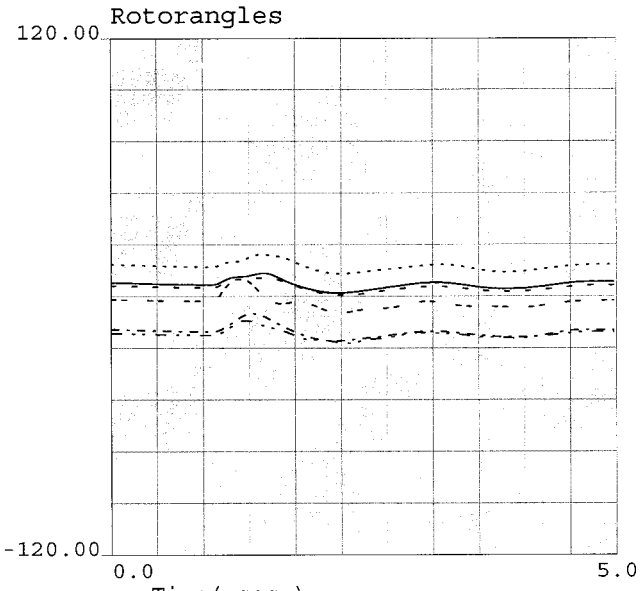


0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
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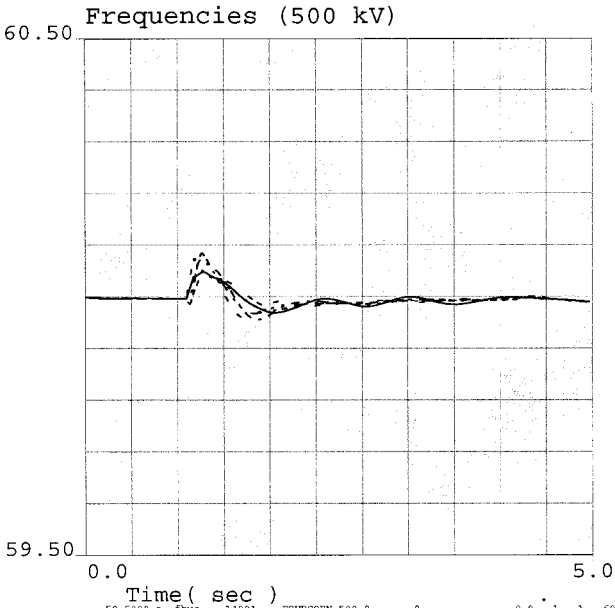

59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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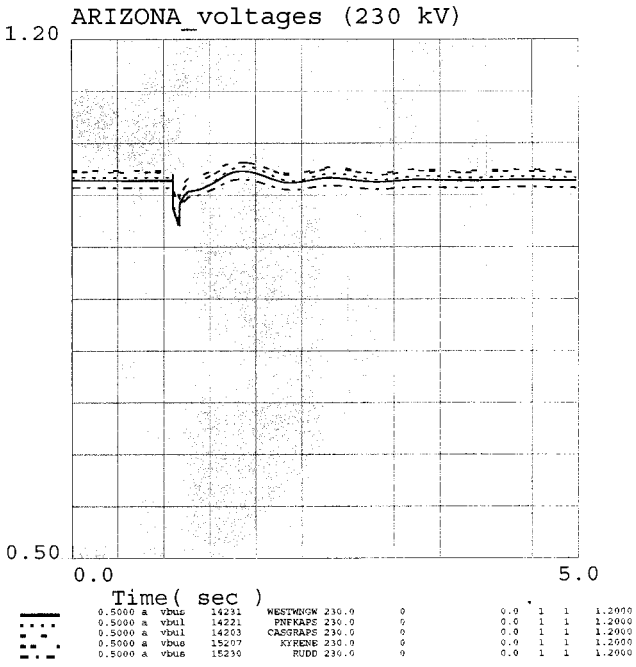

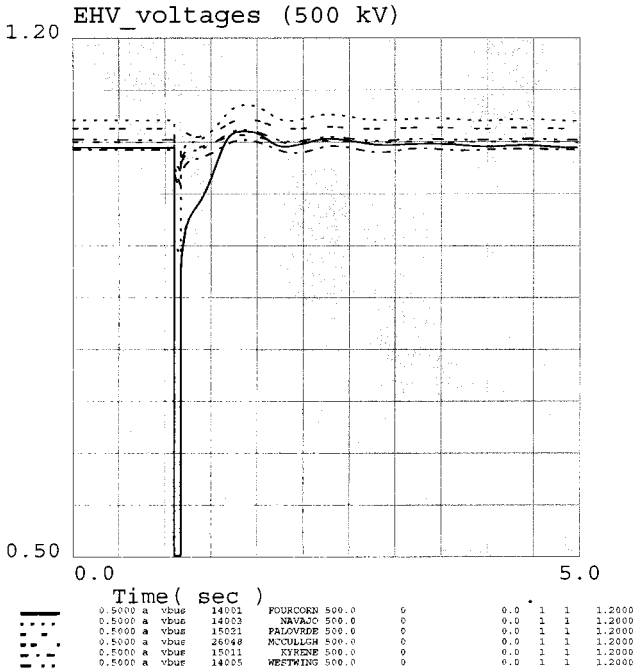

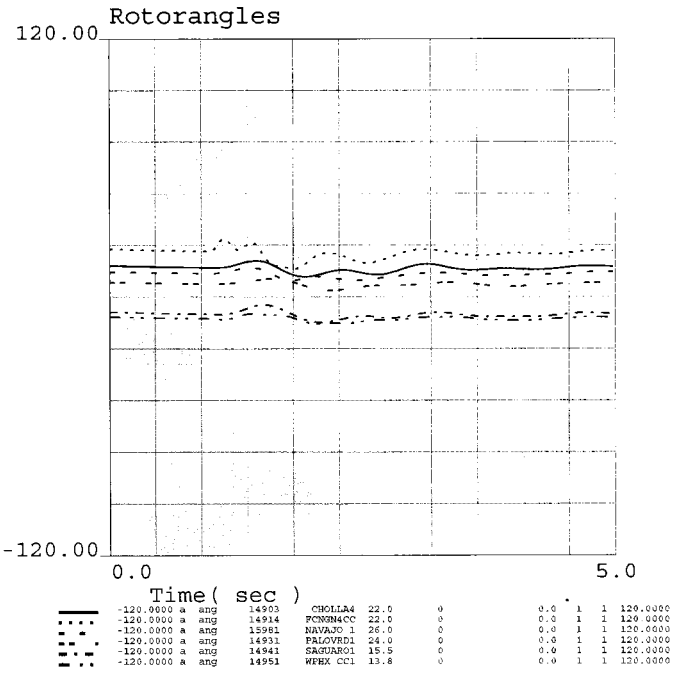

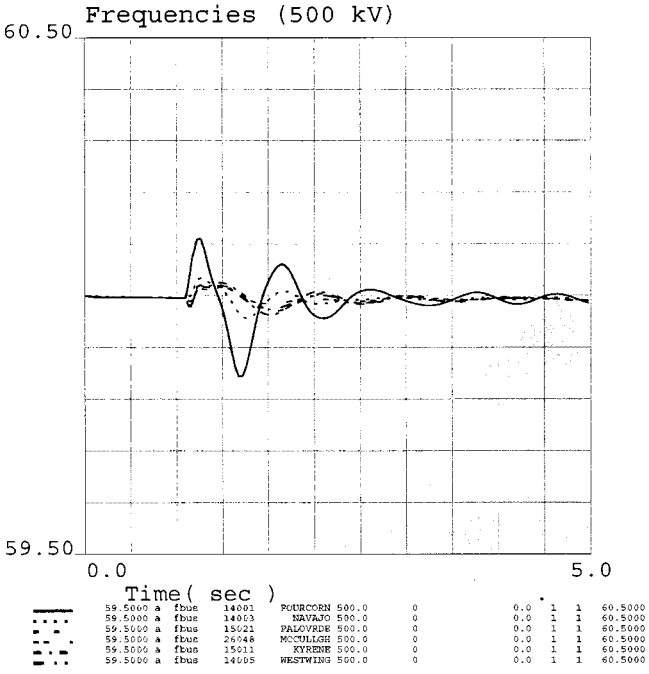

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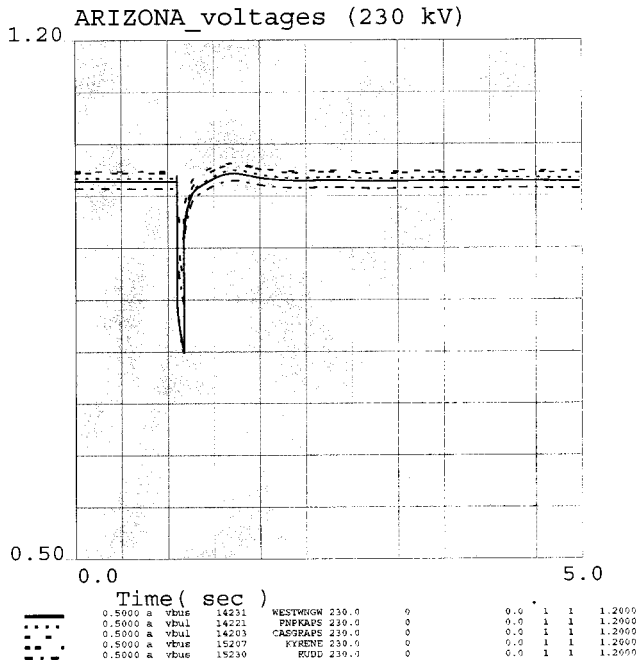

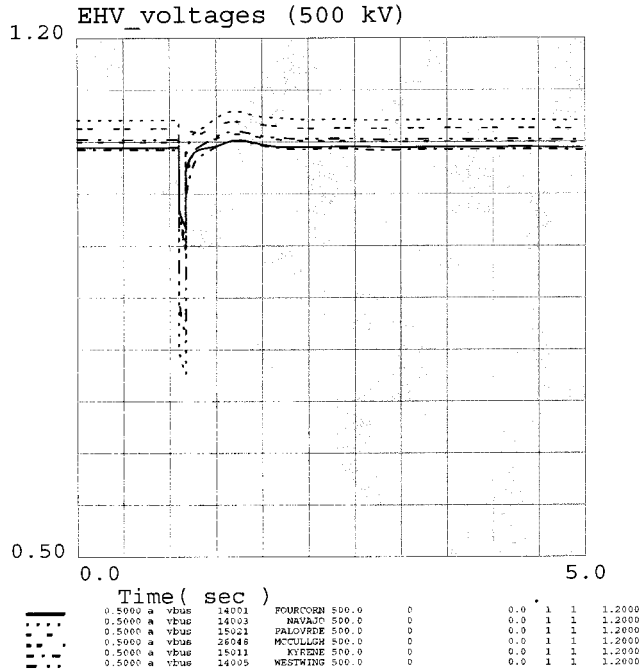

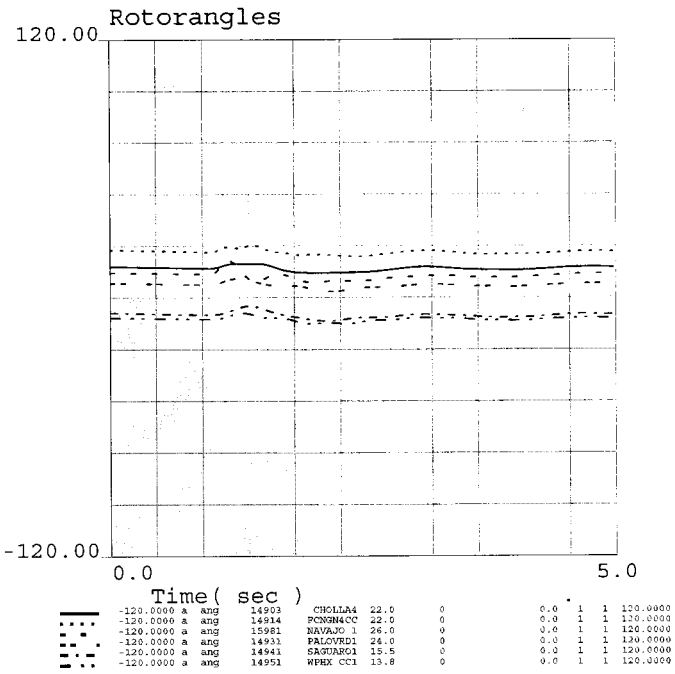

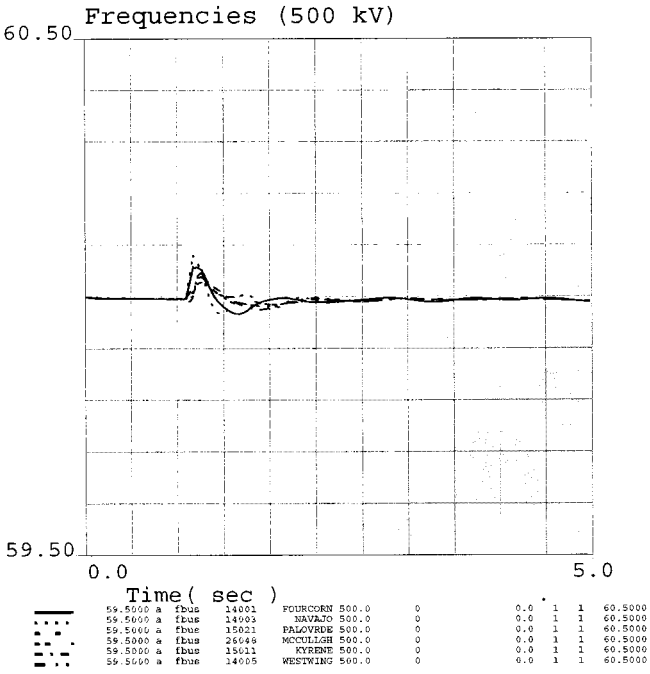

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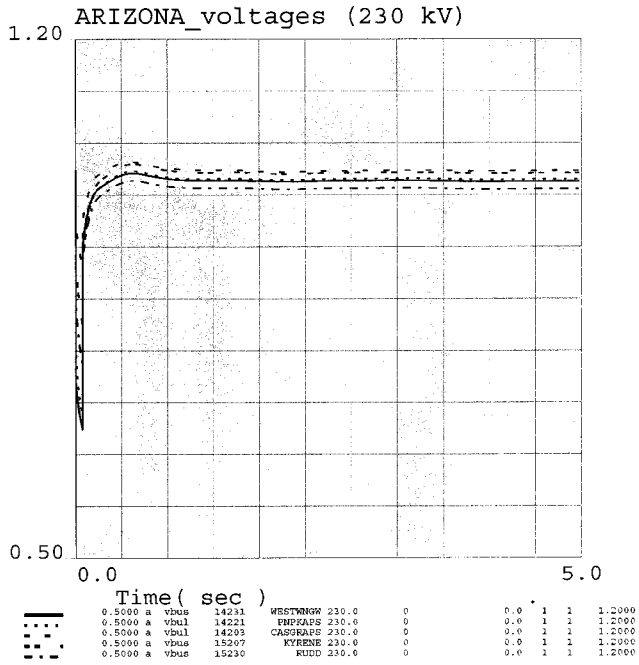

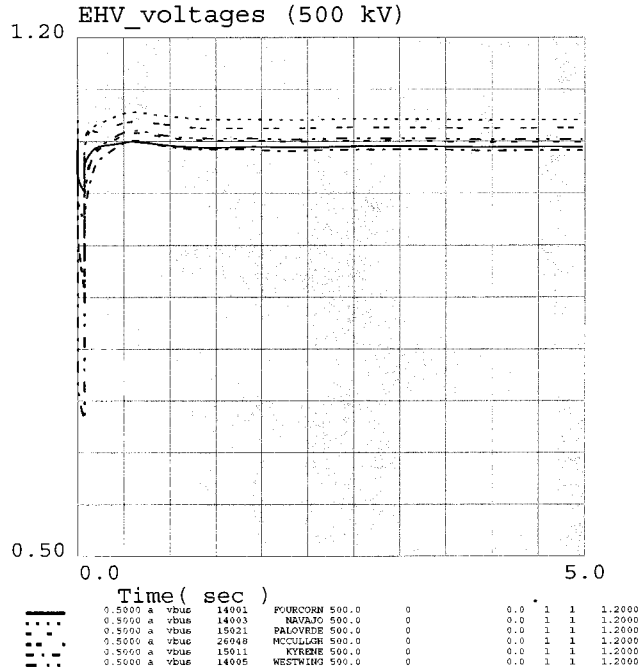

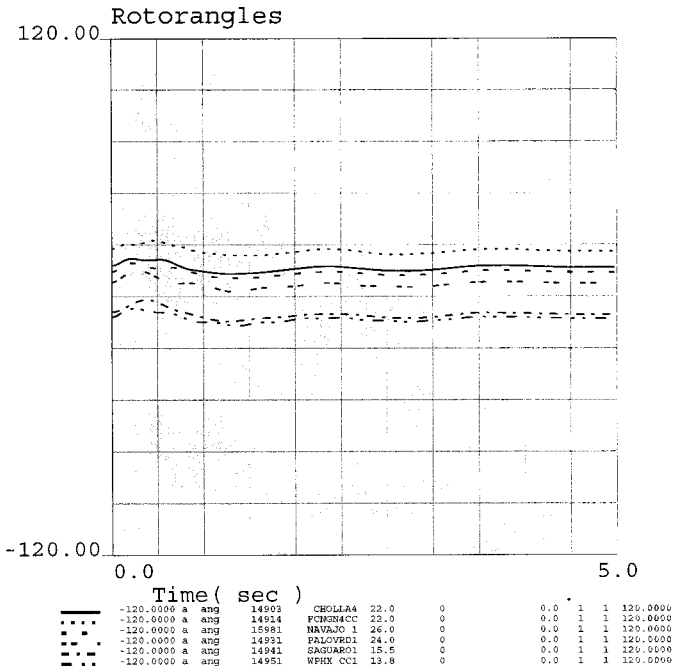

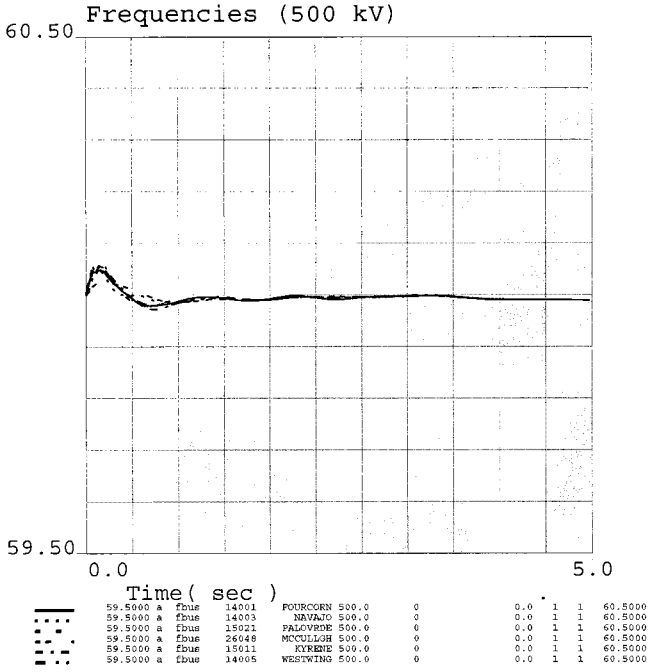

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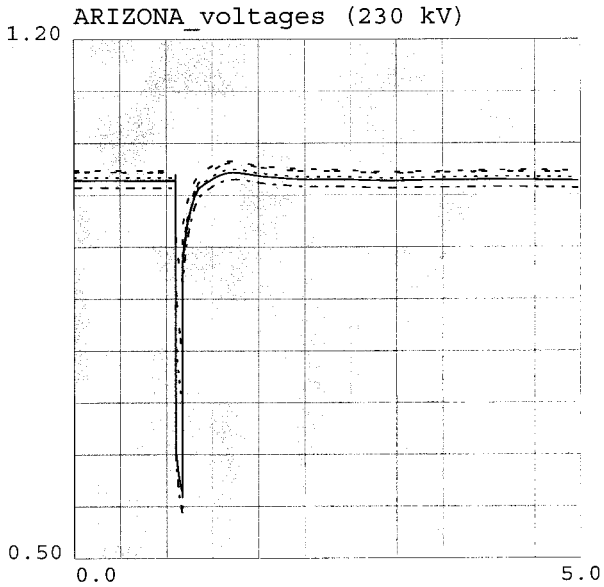
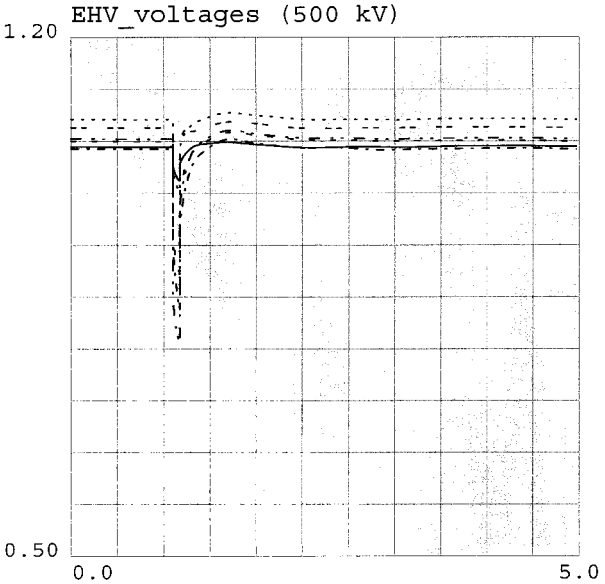
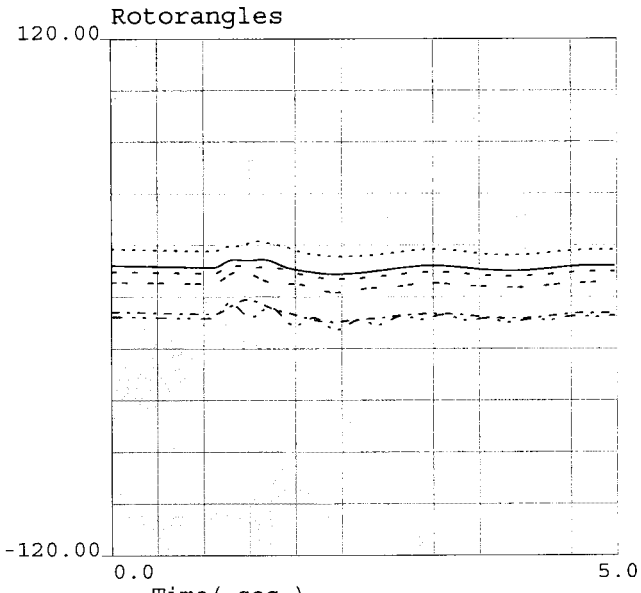


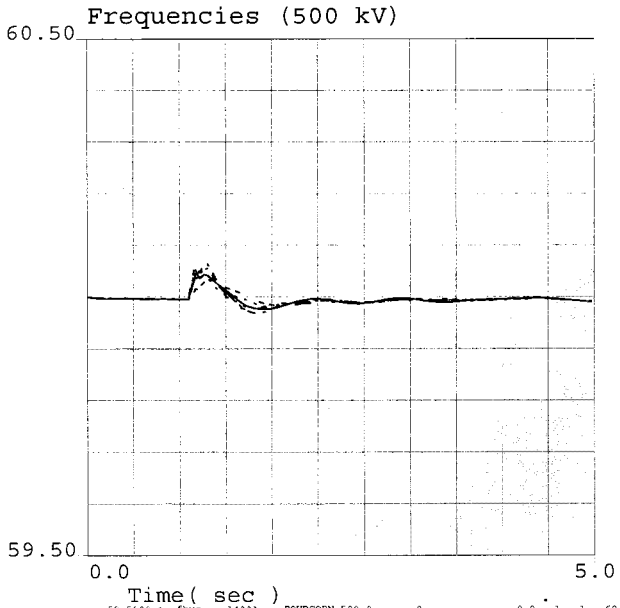
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PHPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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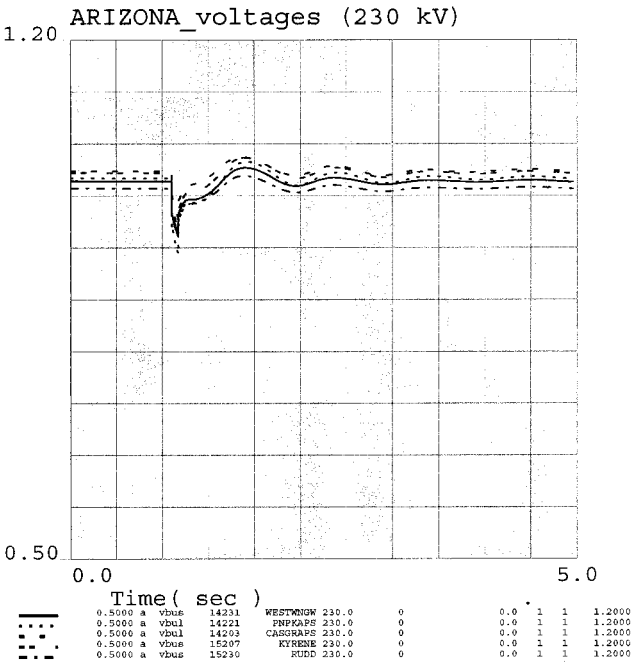

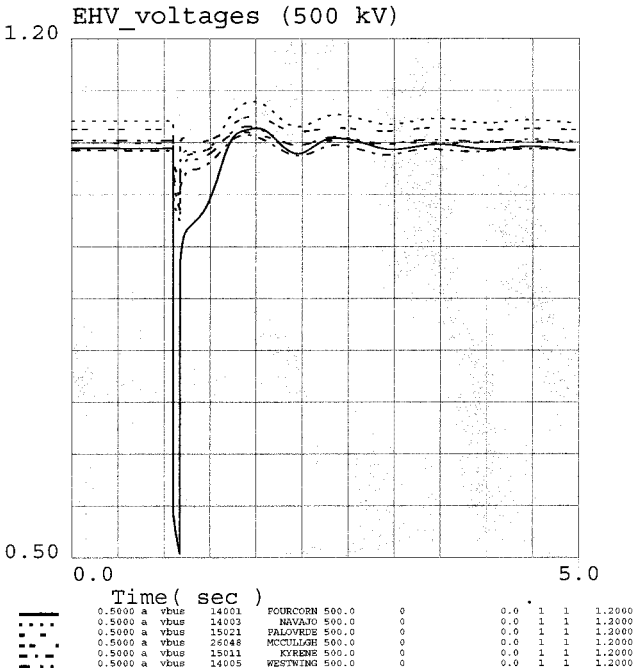

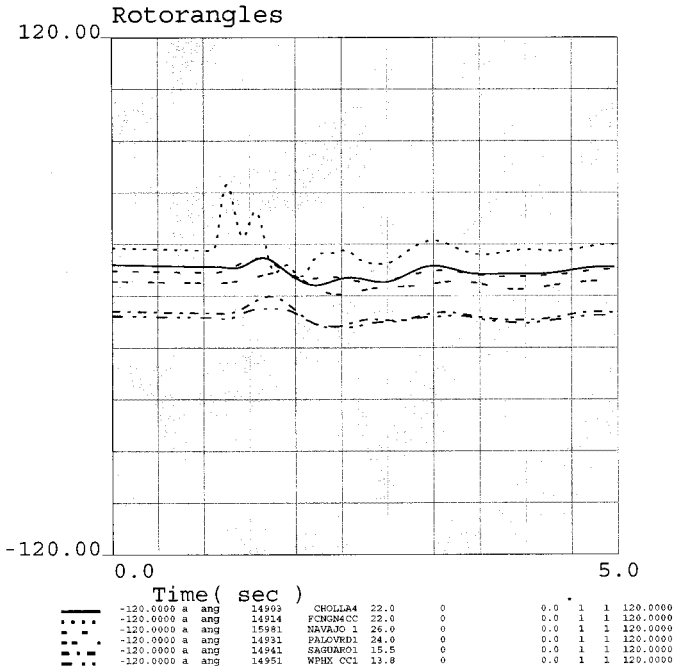

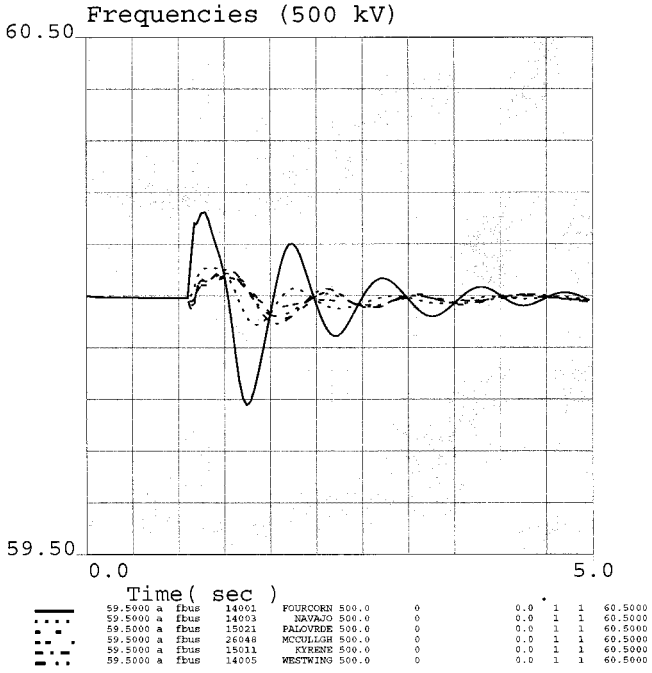

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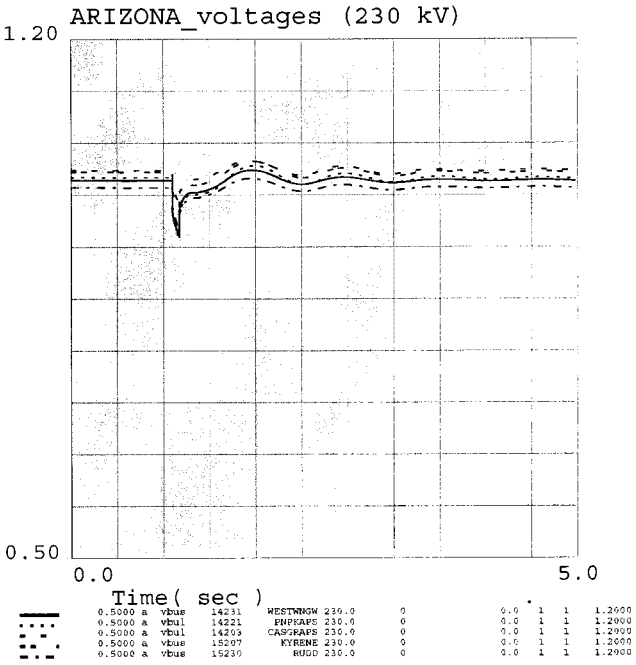

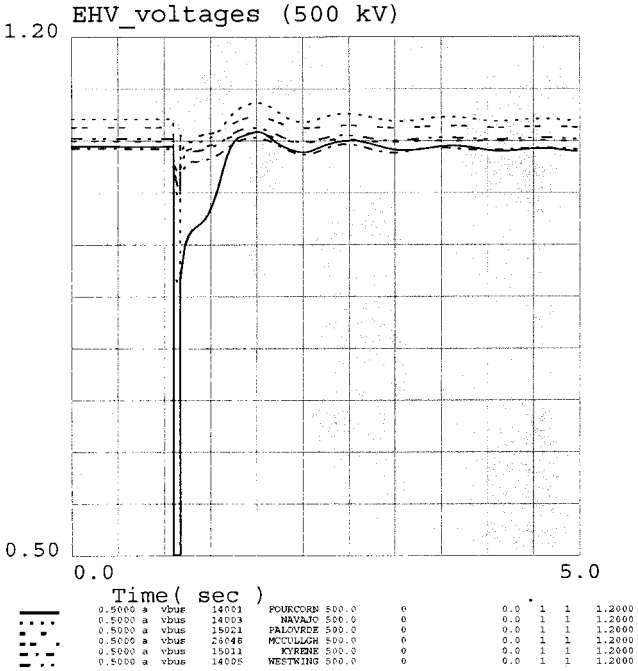

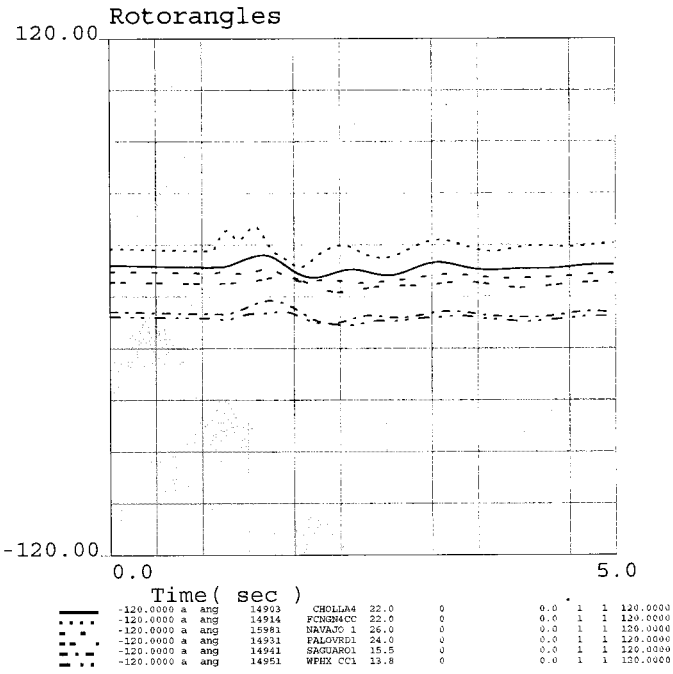

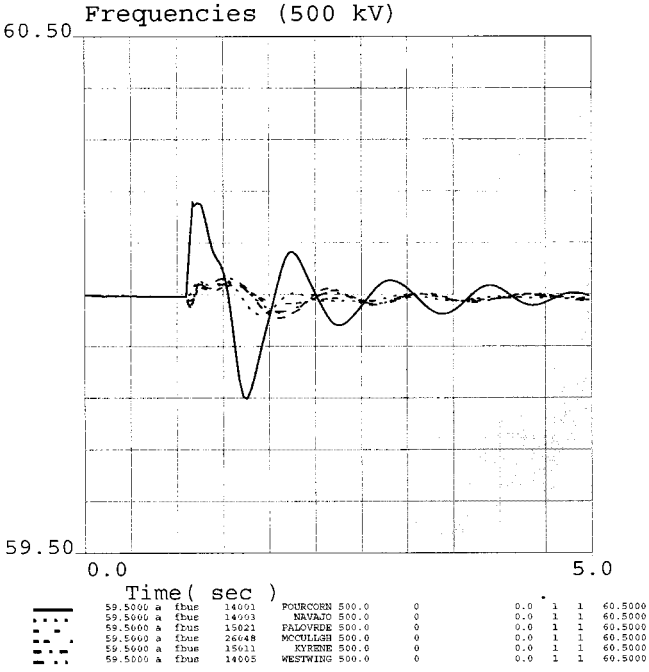

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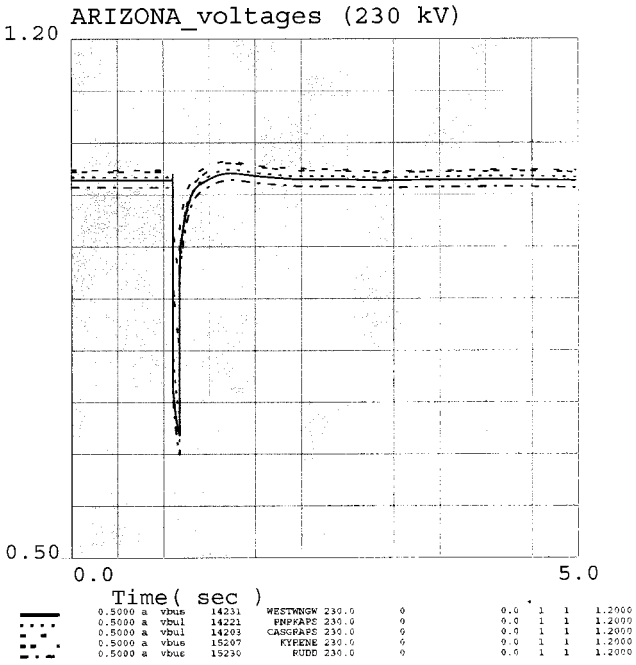

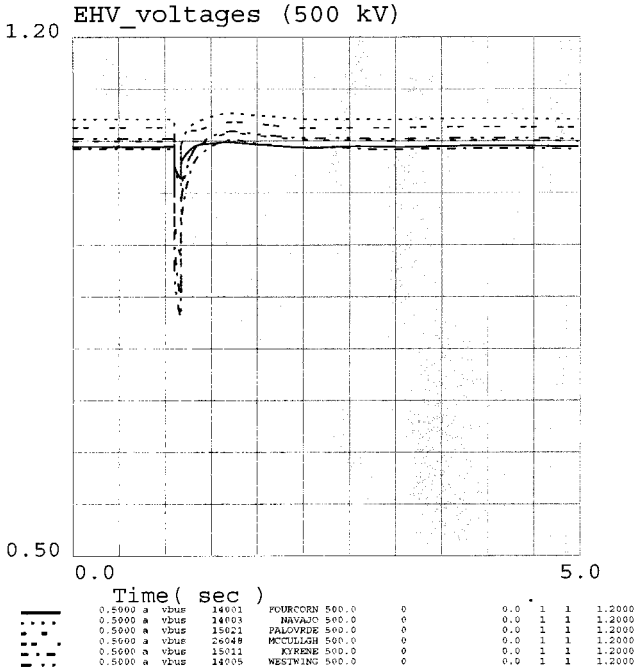

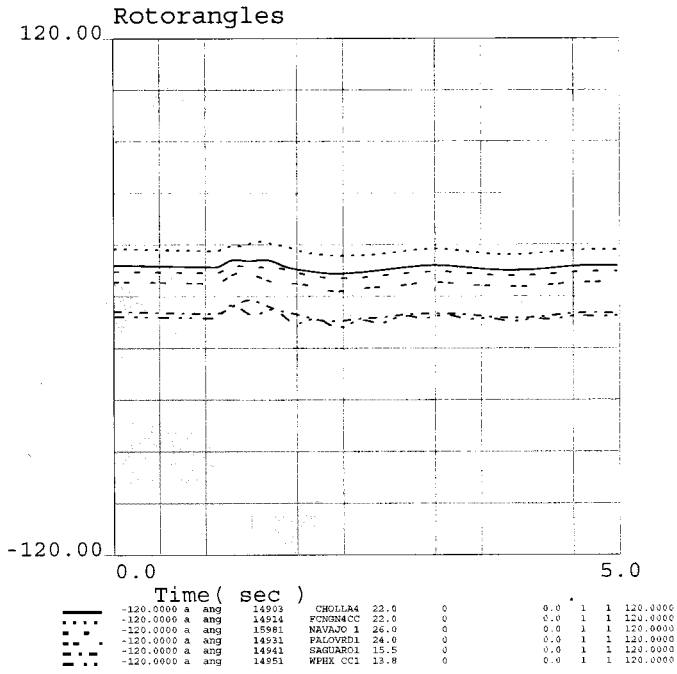

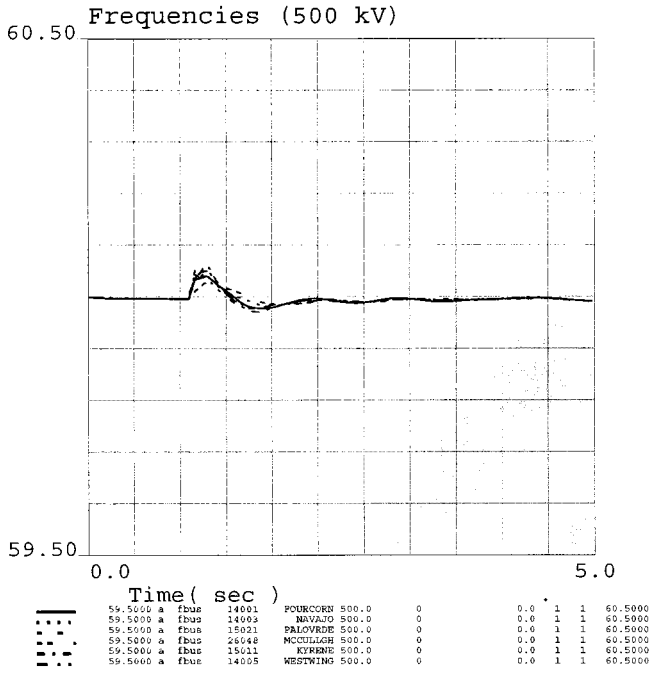

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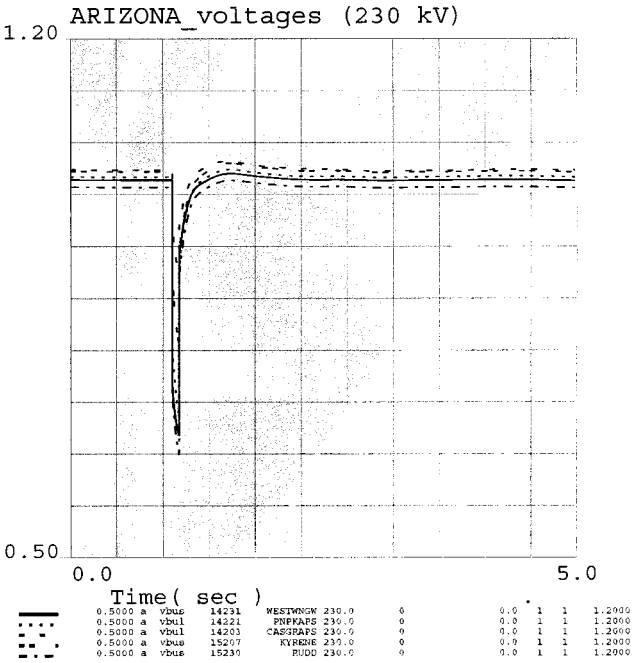

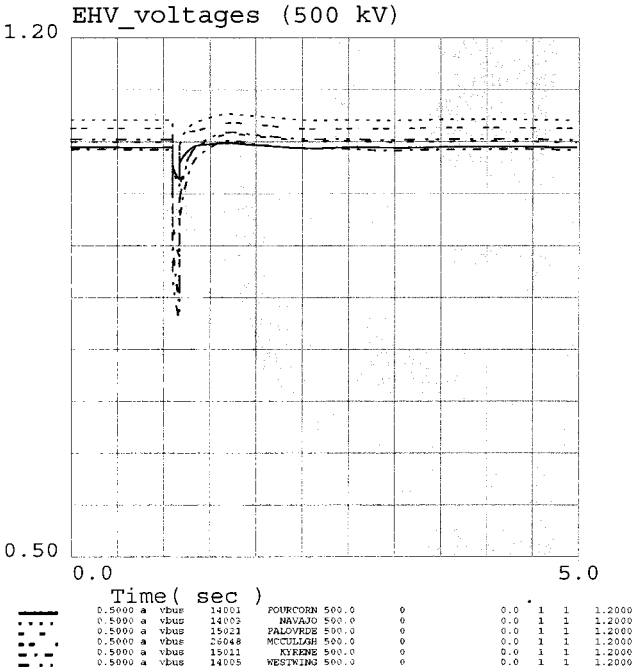

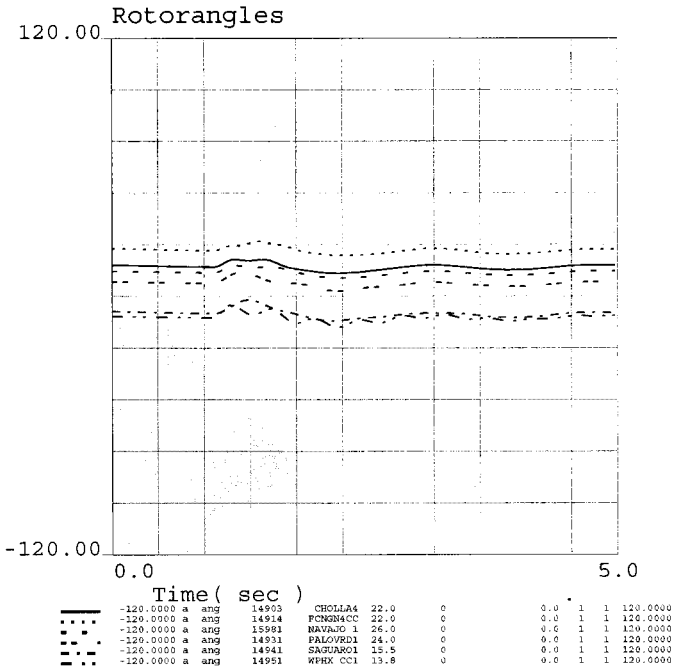

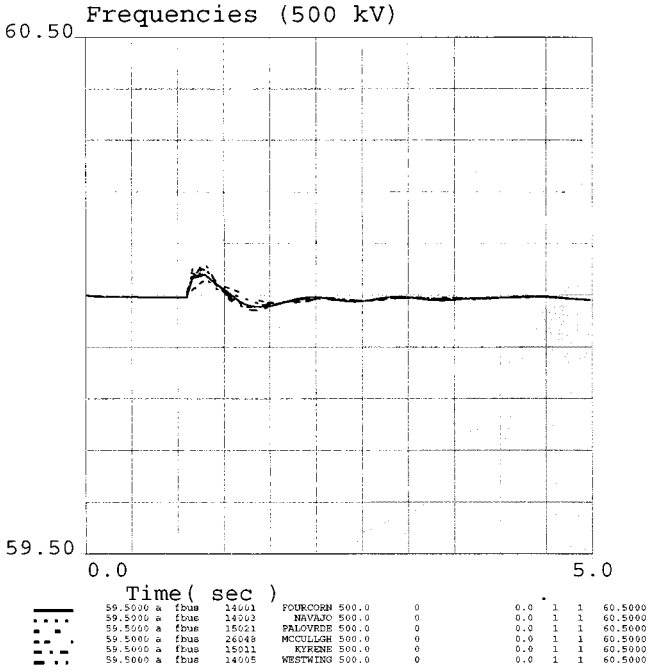

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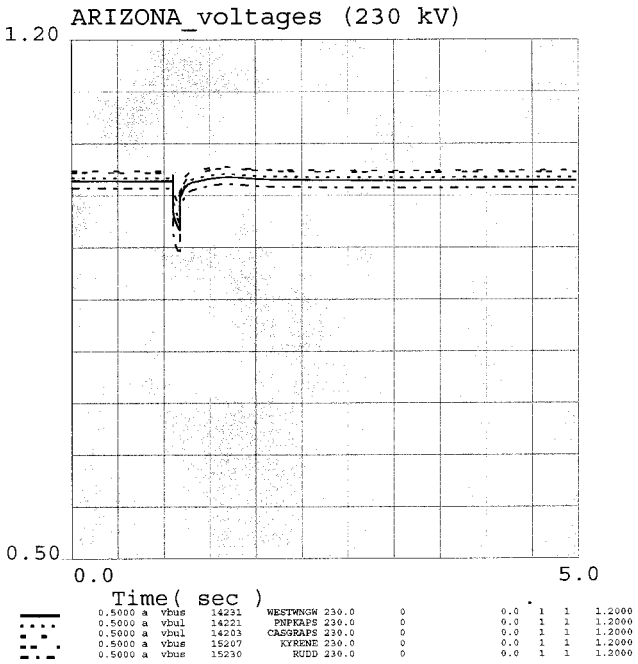

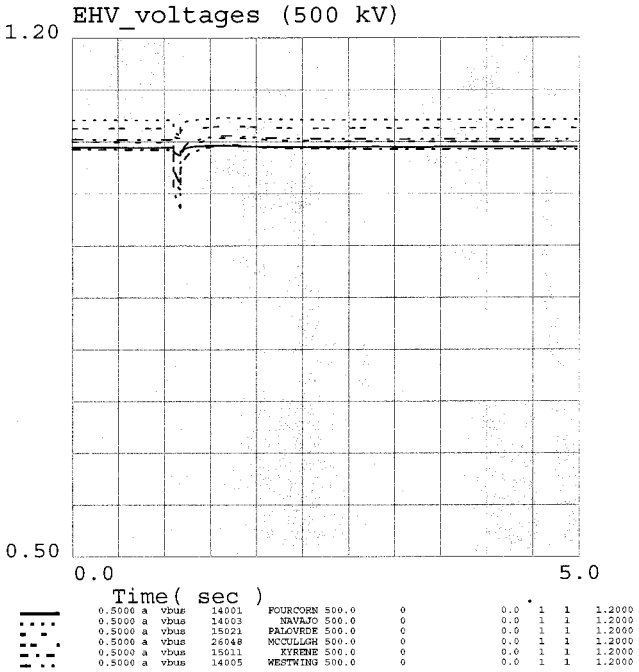

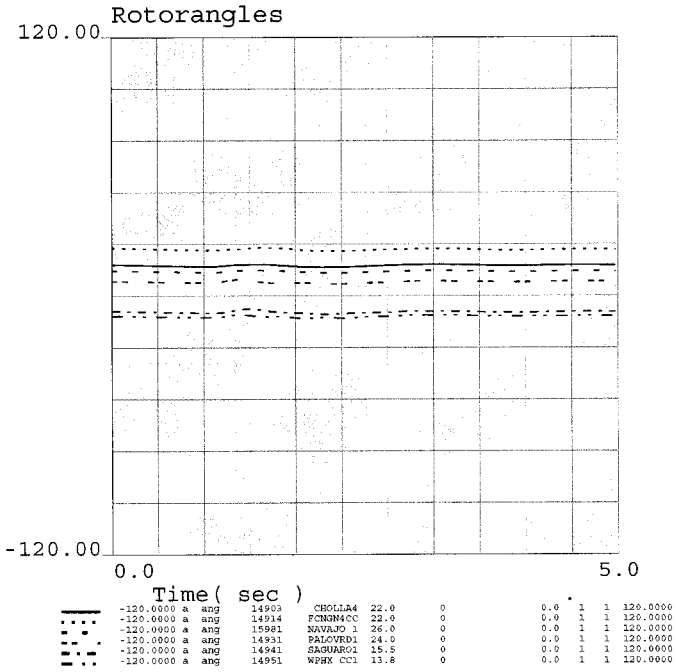

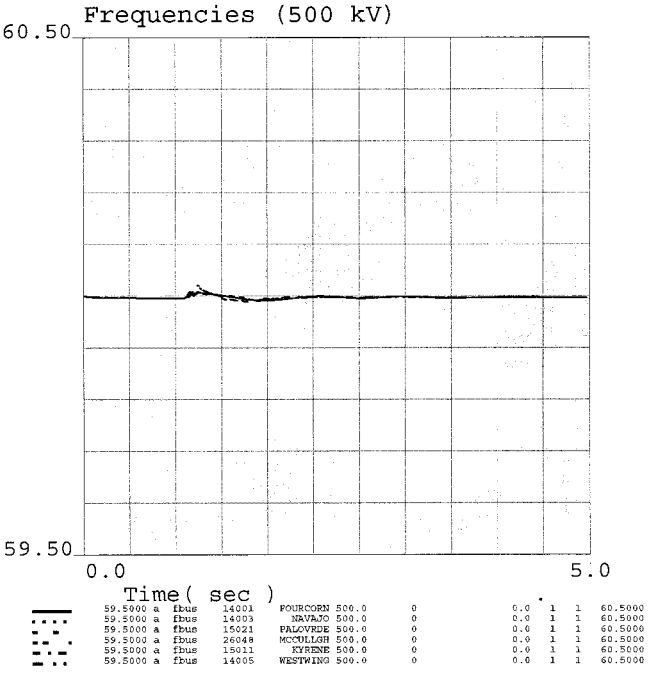

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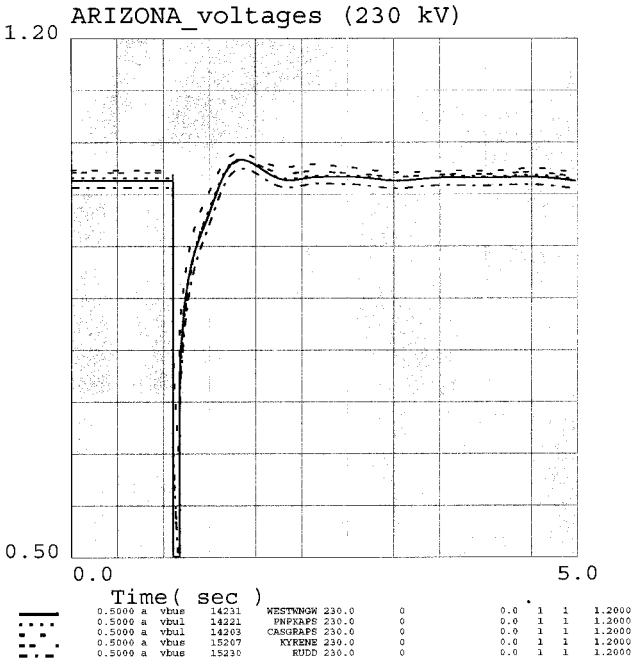

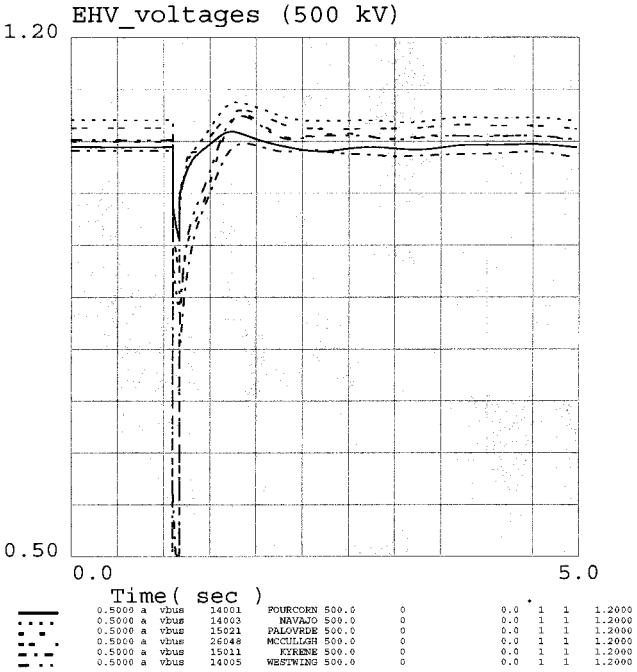

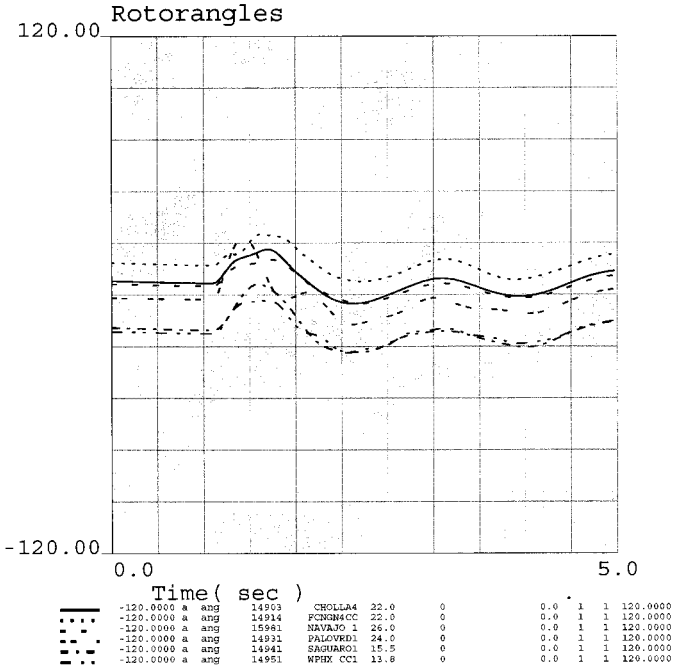

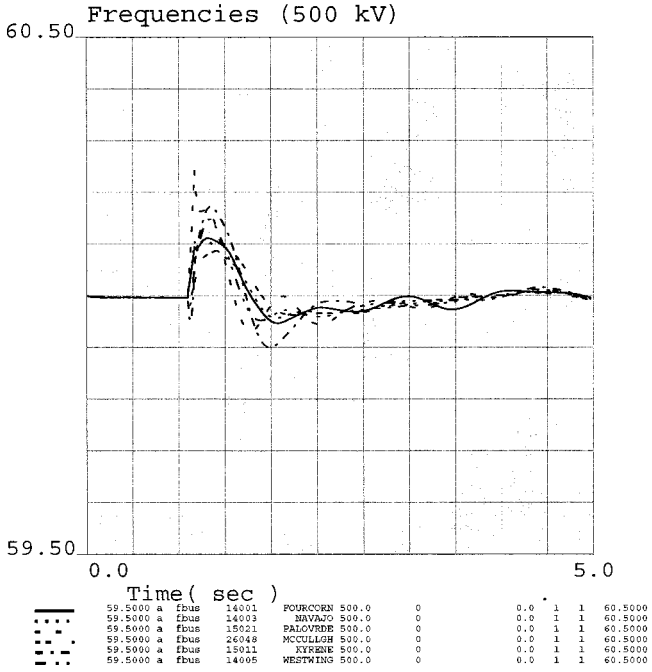

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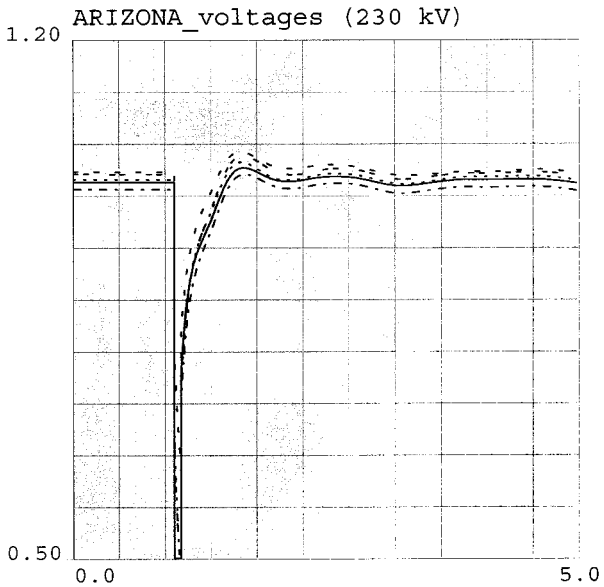
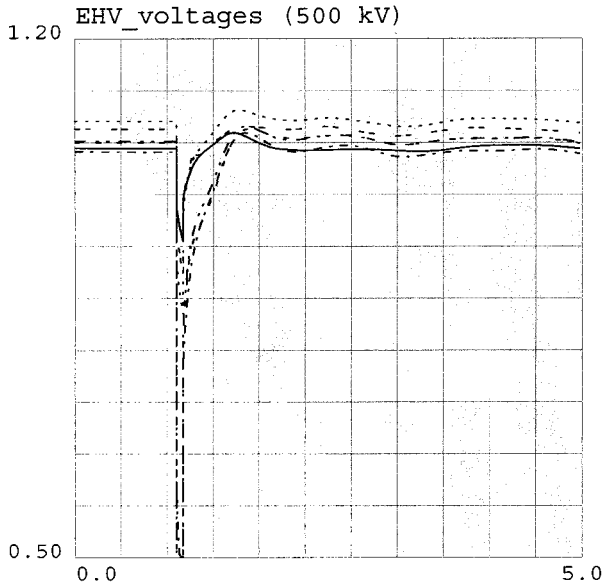
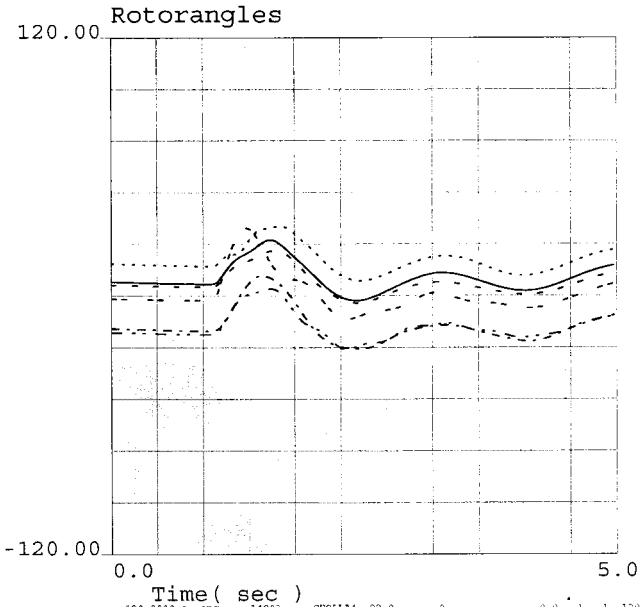


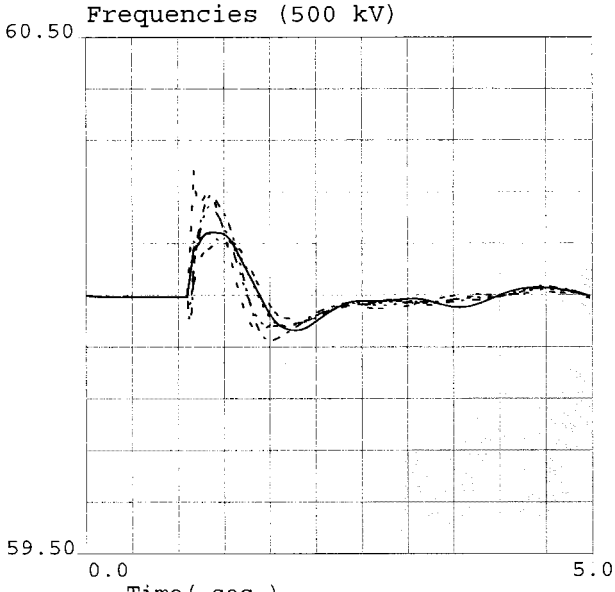
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14921	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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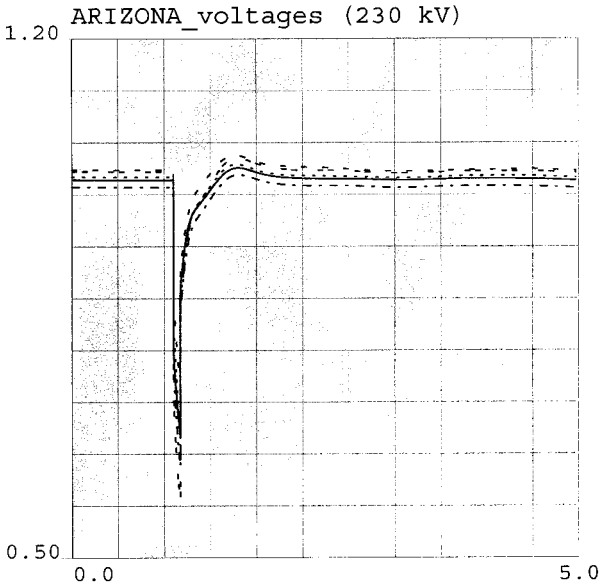
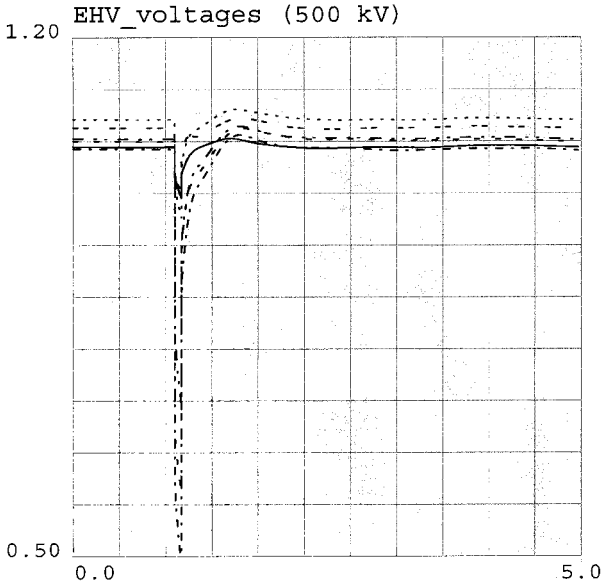
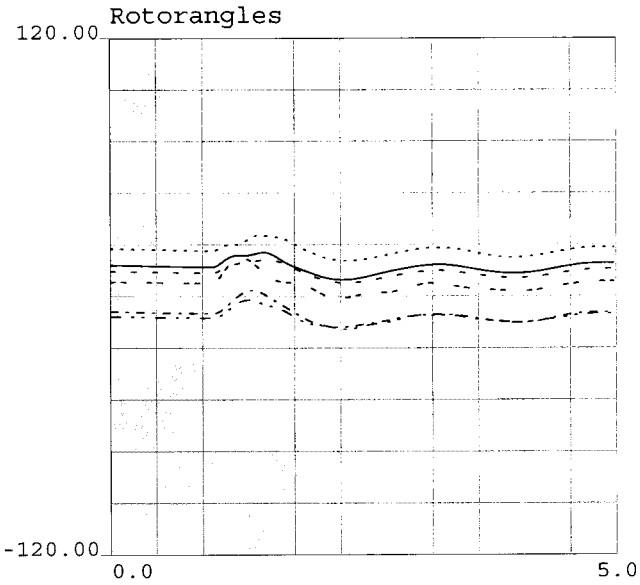


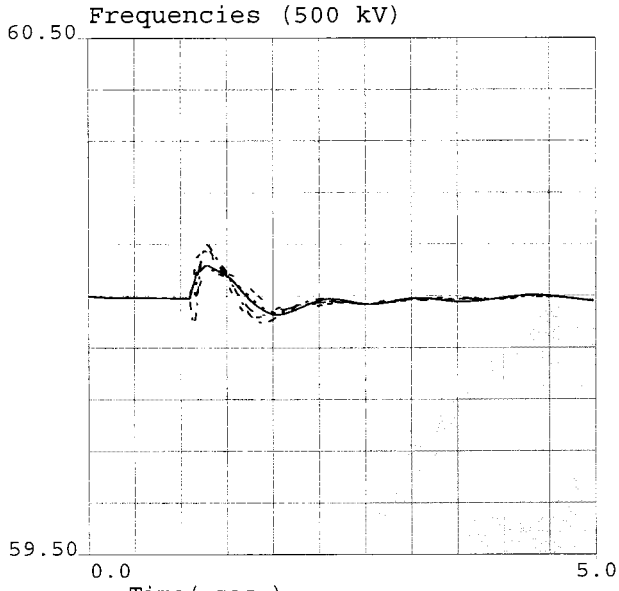
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PHPKARS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14293	CASGRAFS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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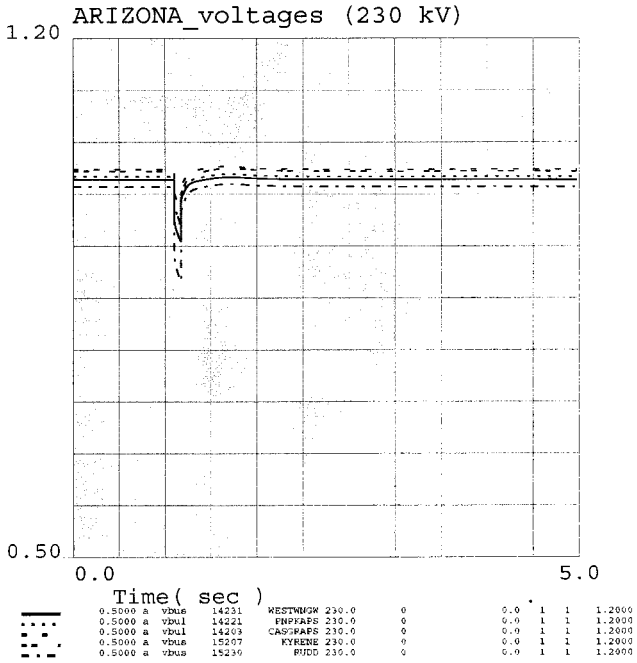

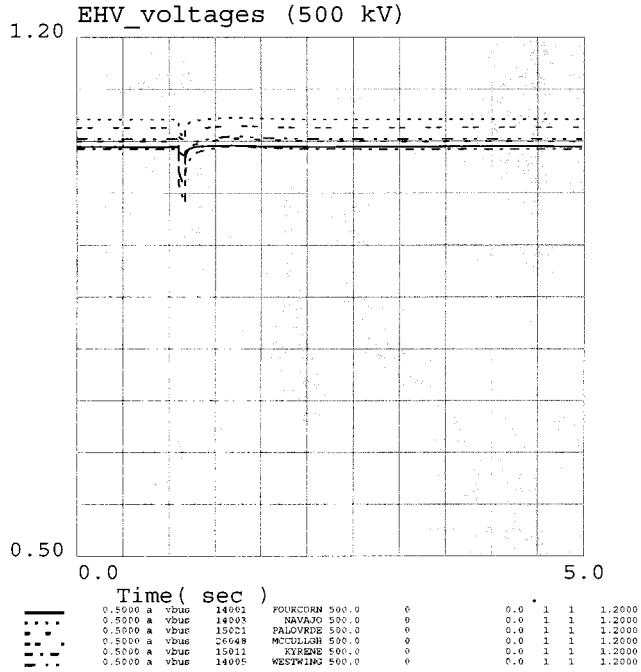

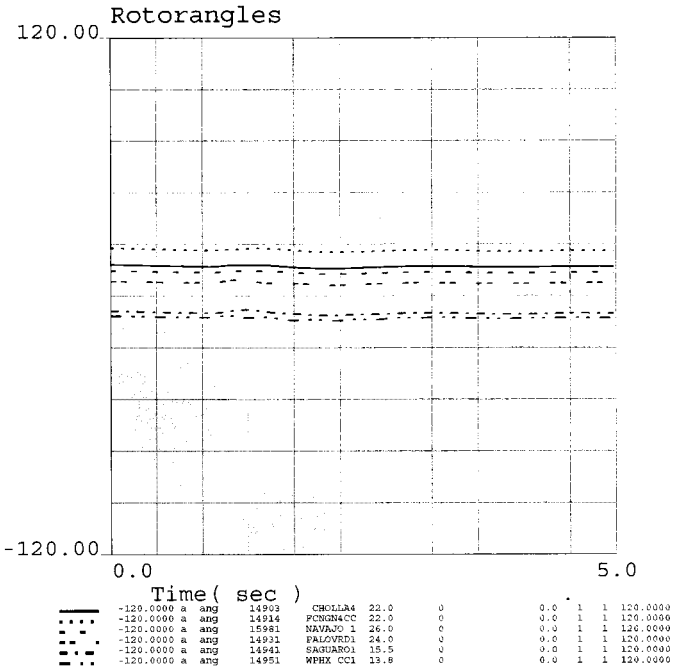

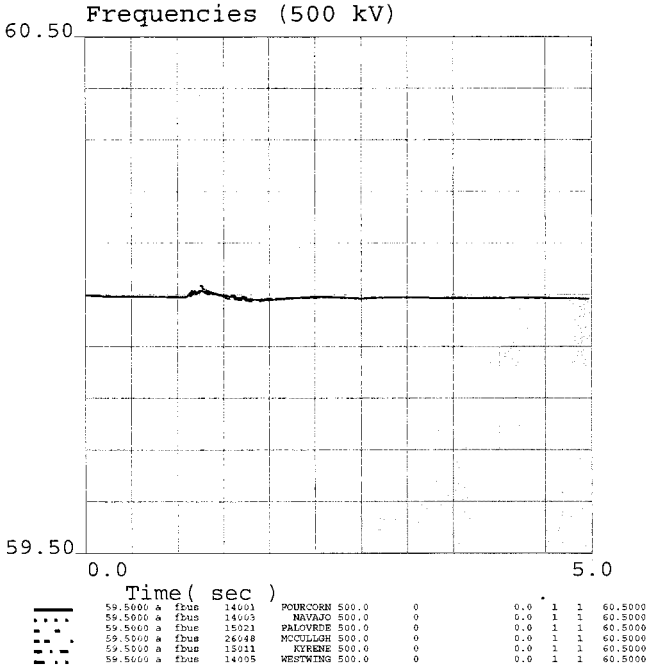

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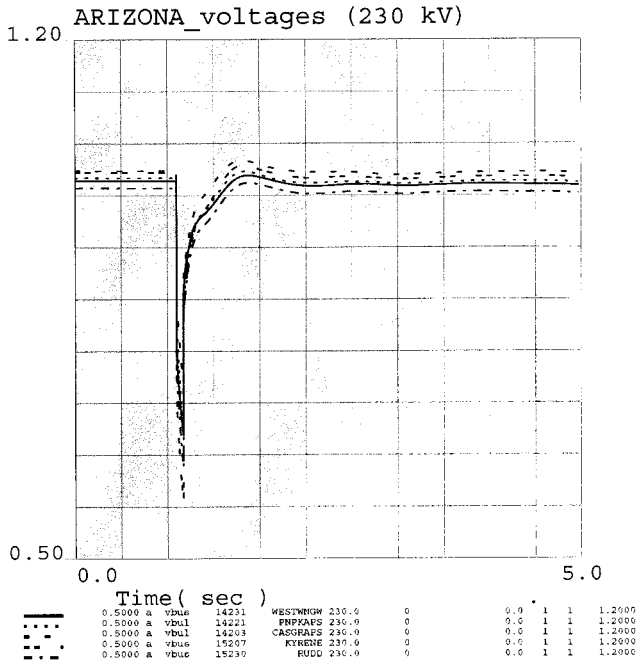

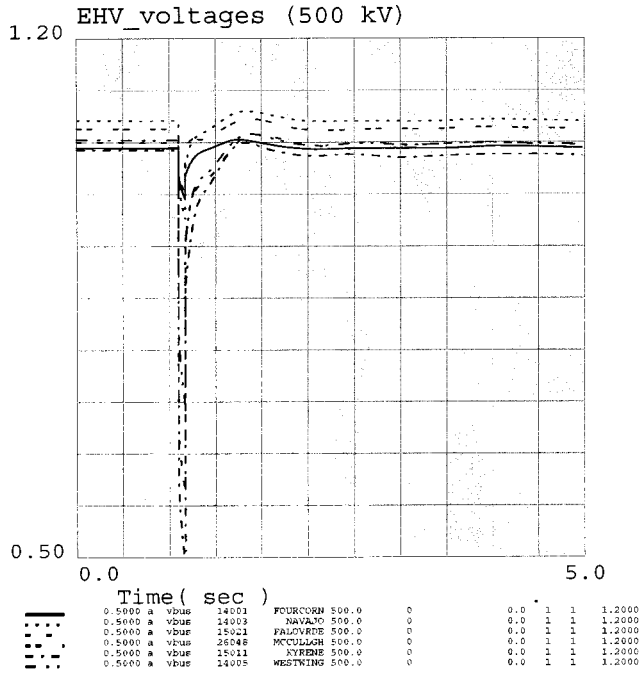

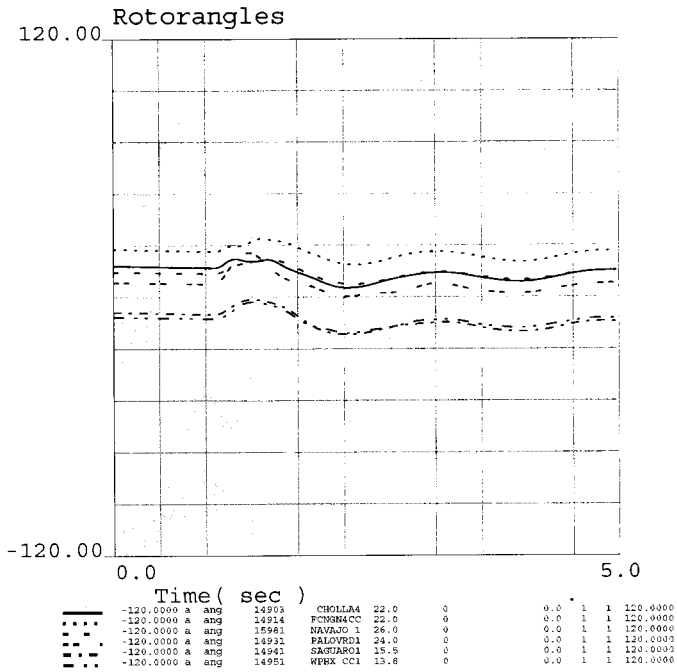

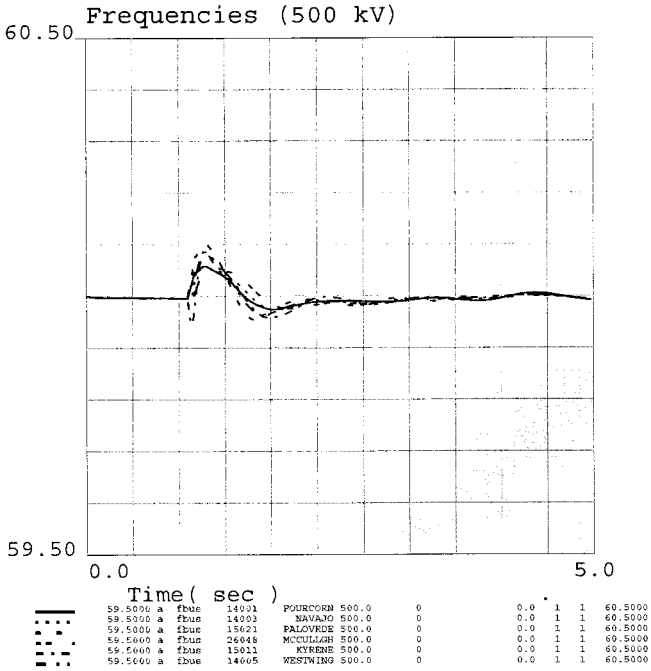

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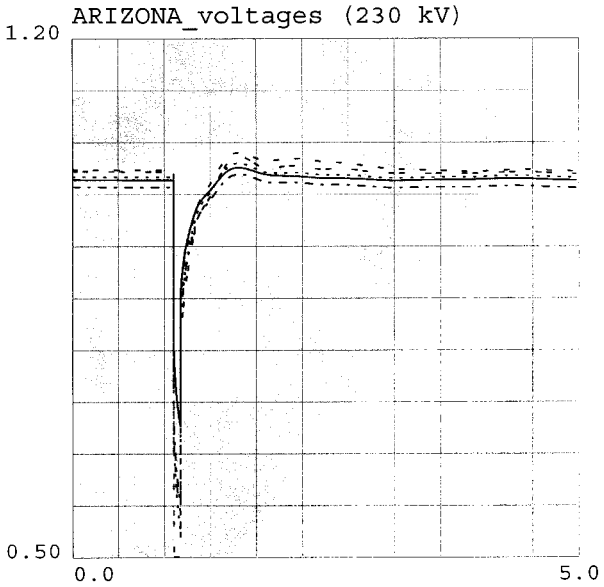
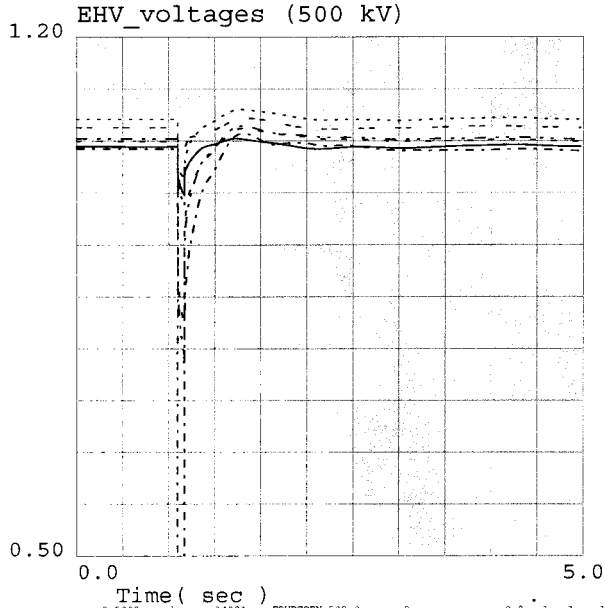
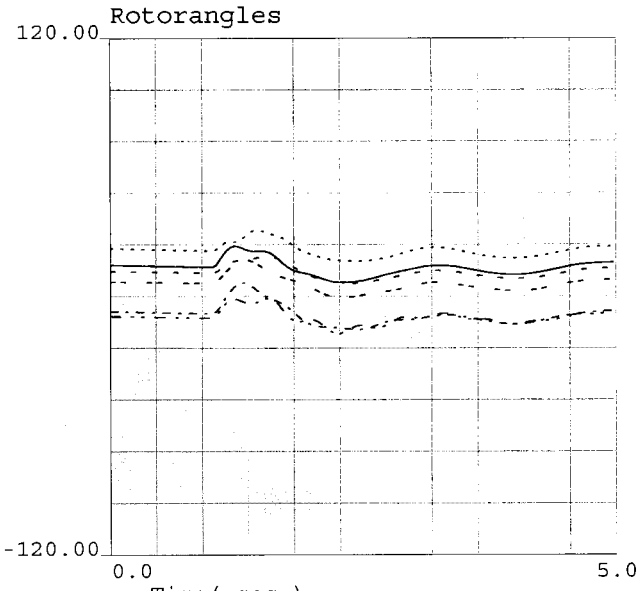


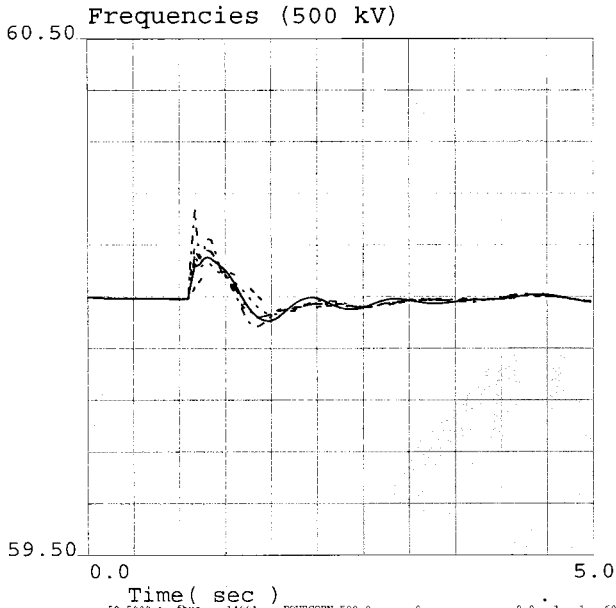
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	FNPWAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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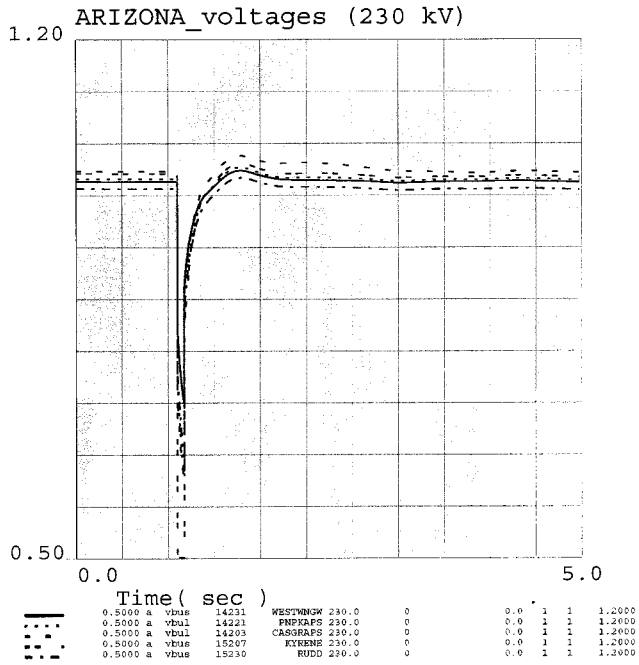

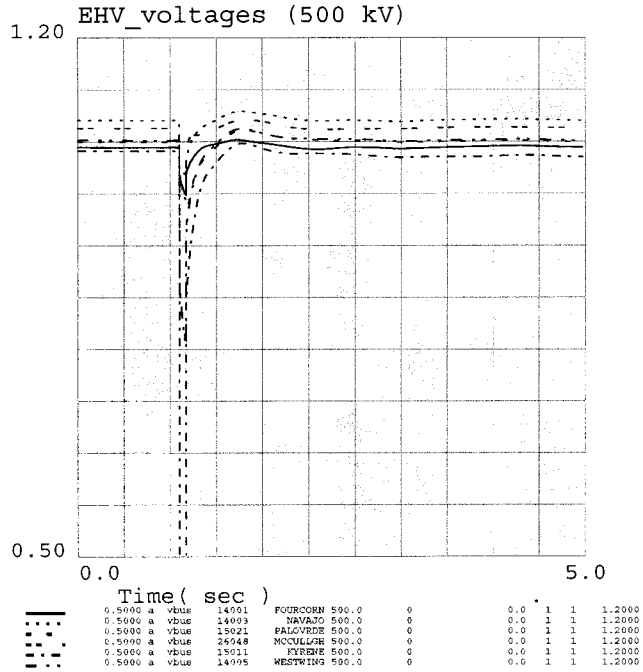

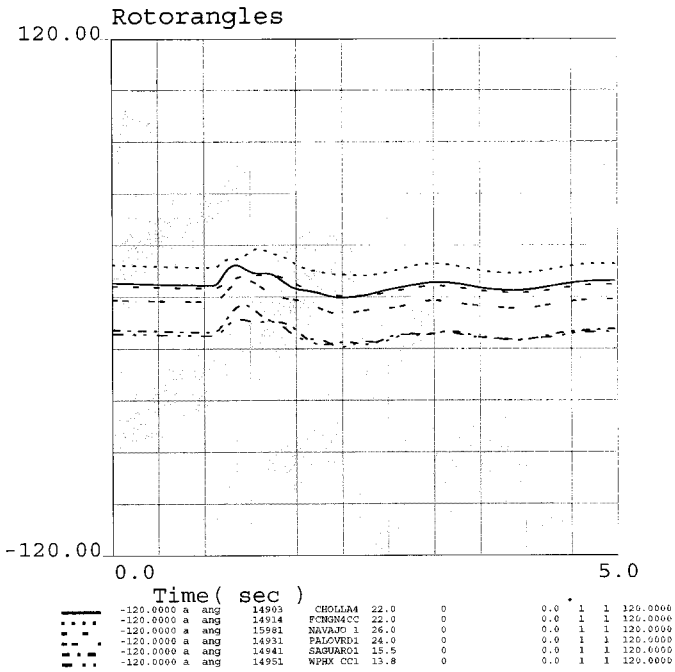

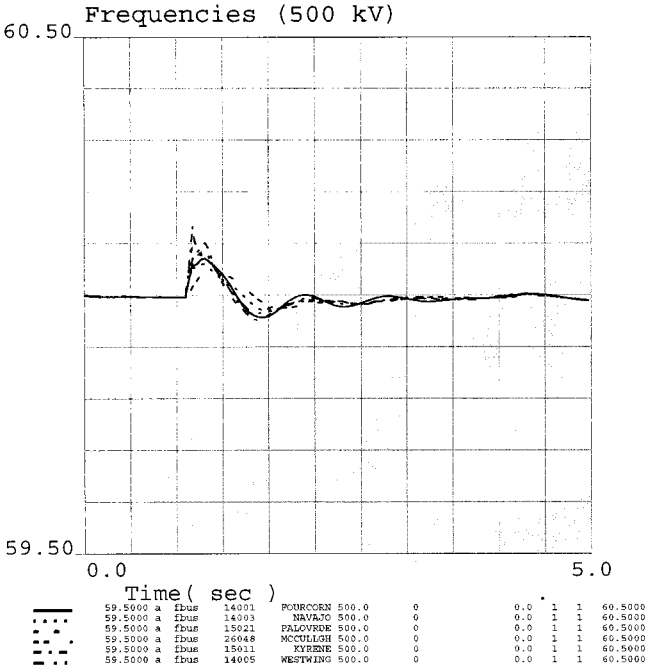

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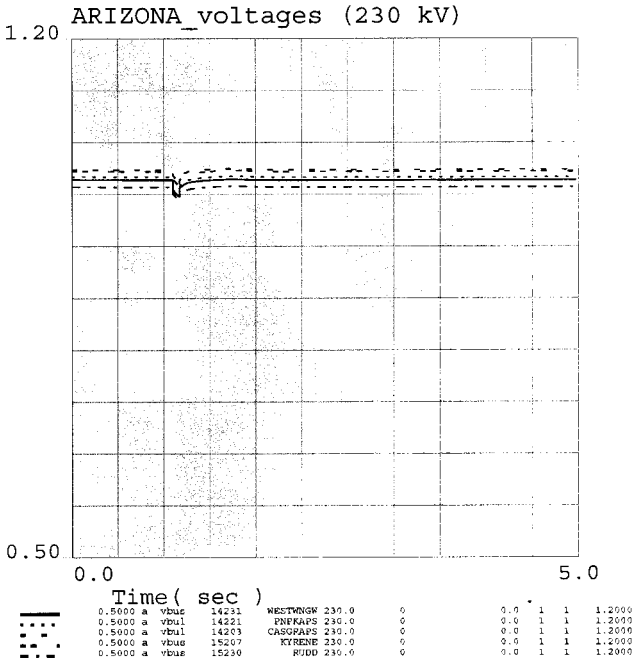

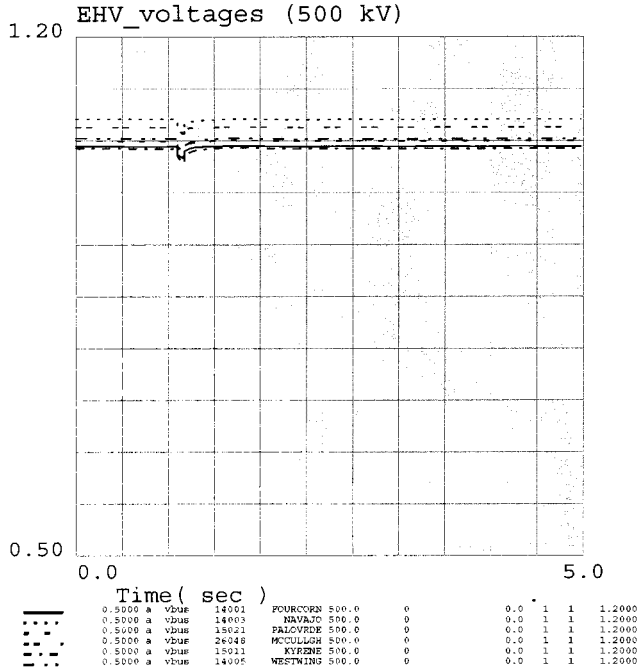

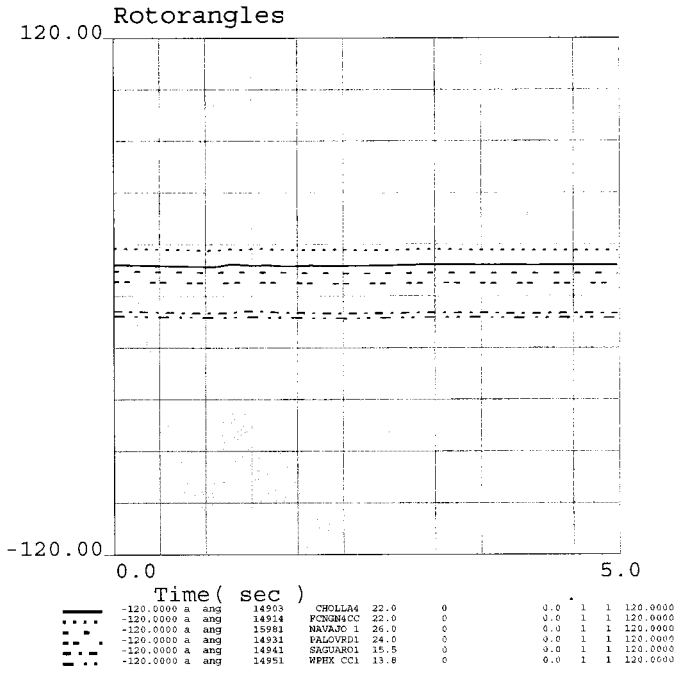

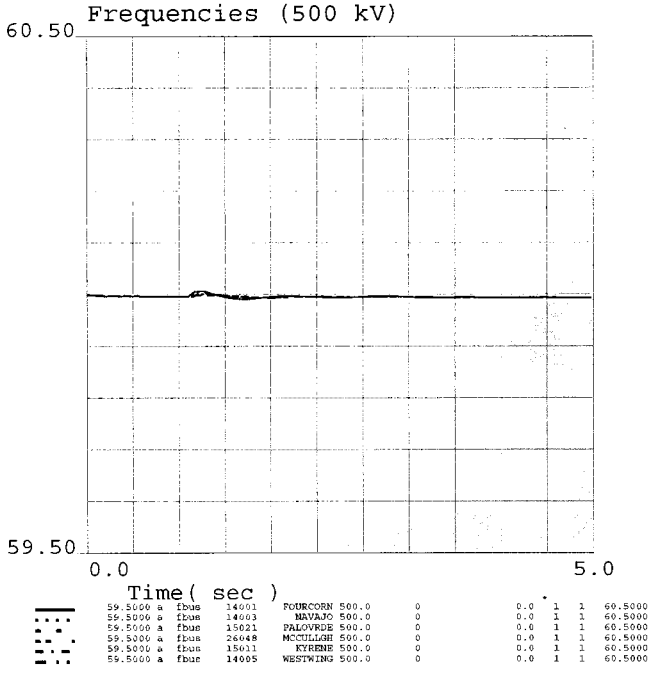

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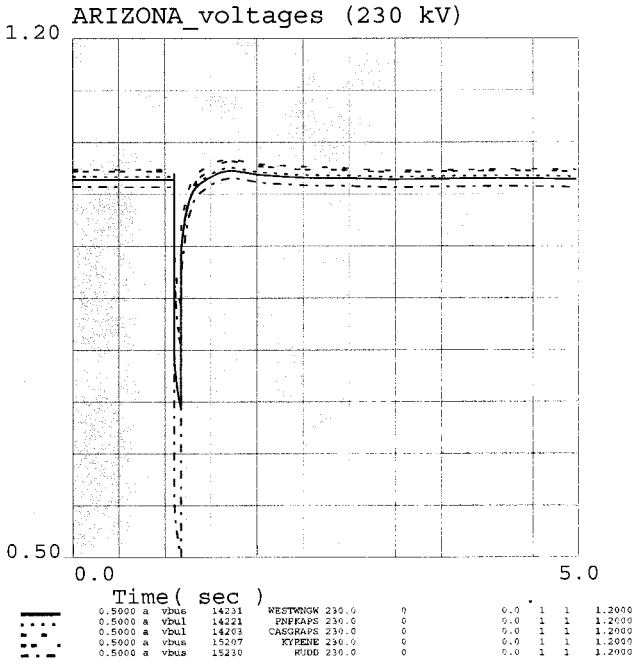

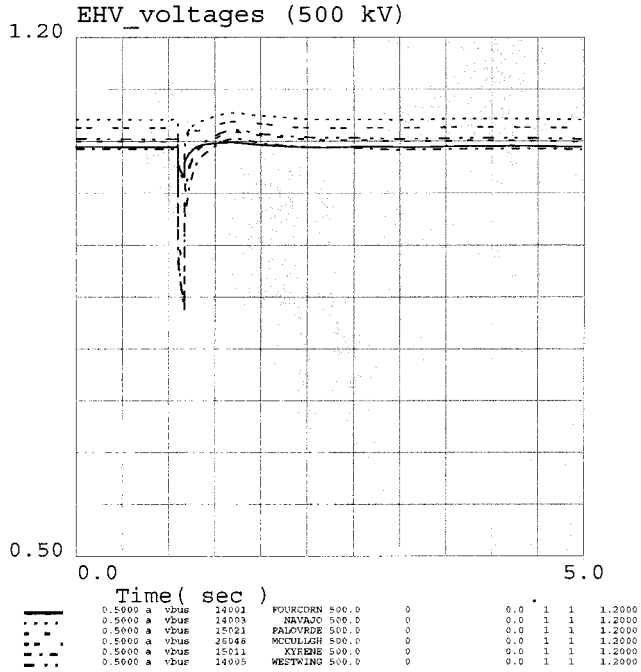

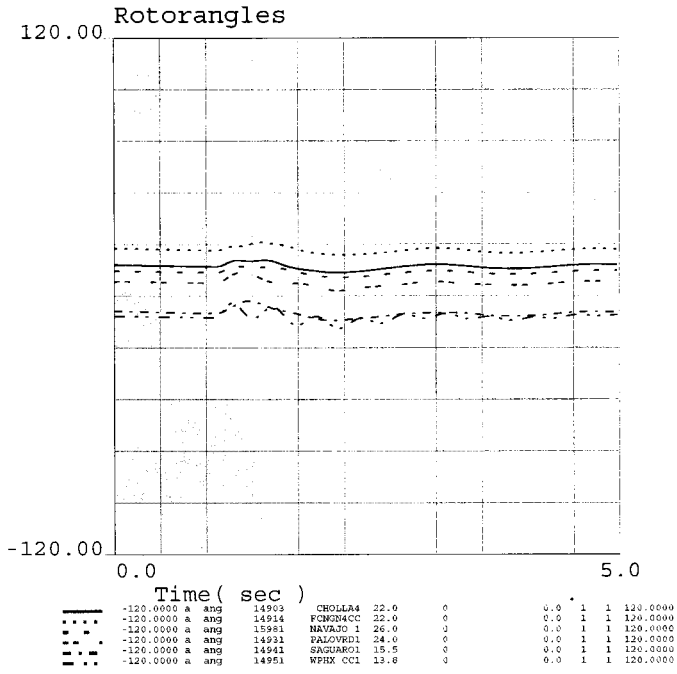

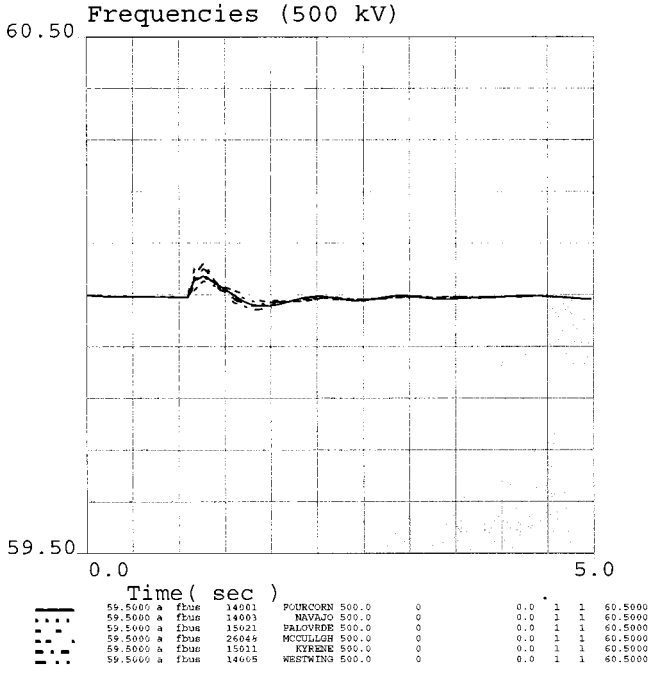

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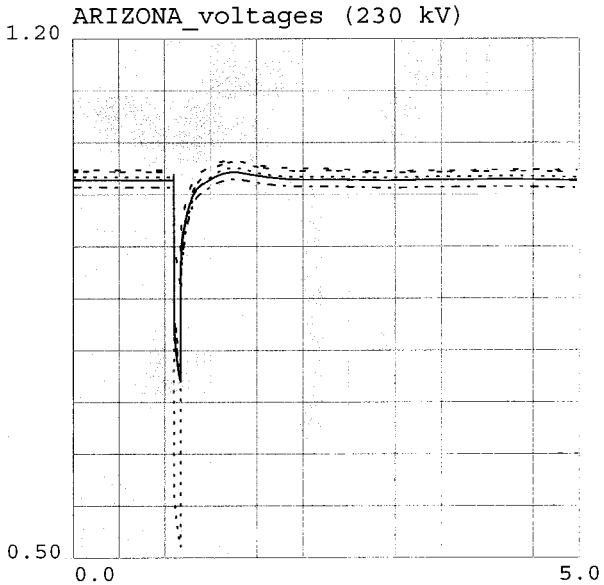
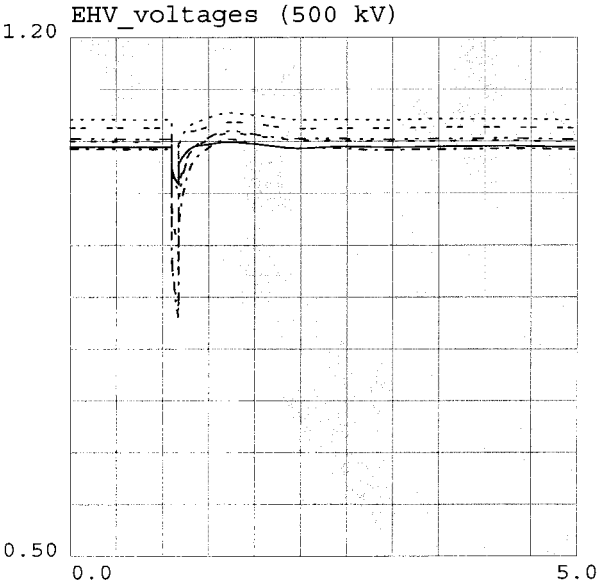
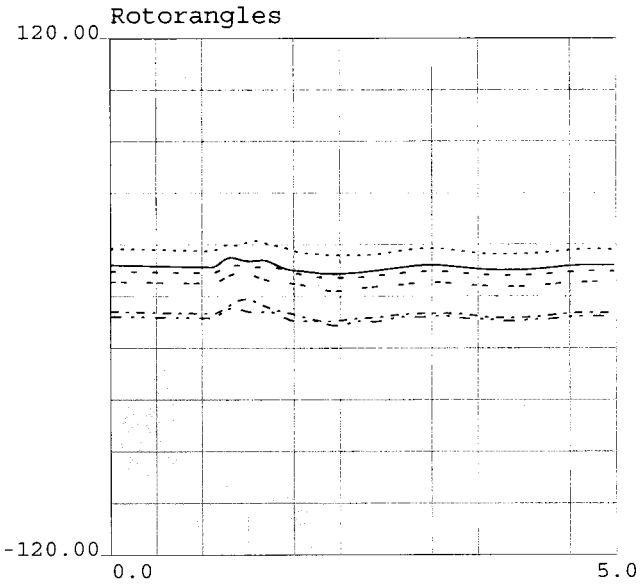


0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PHPXARS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRARS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
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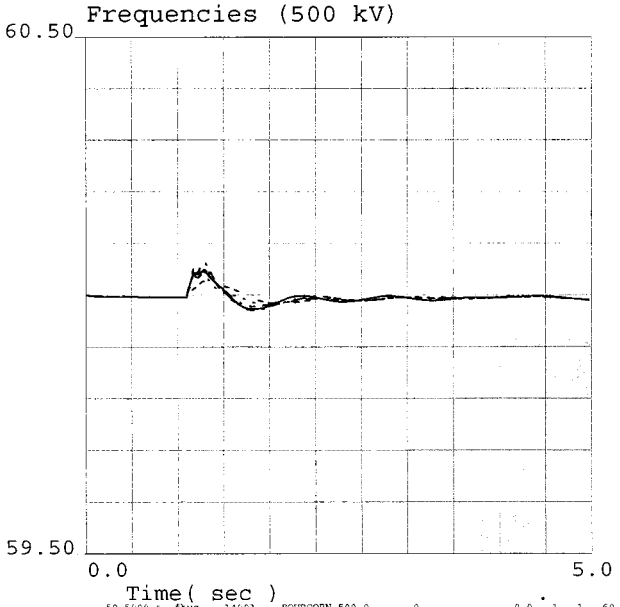
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14921	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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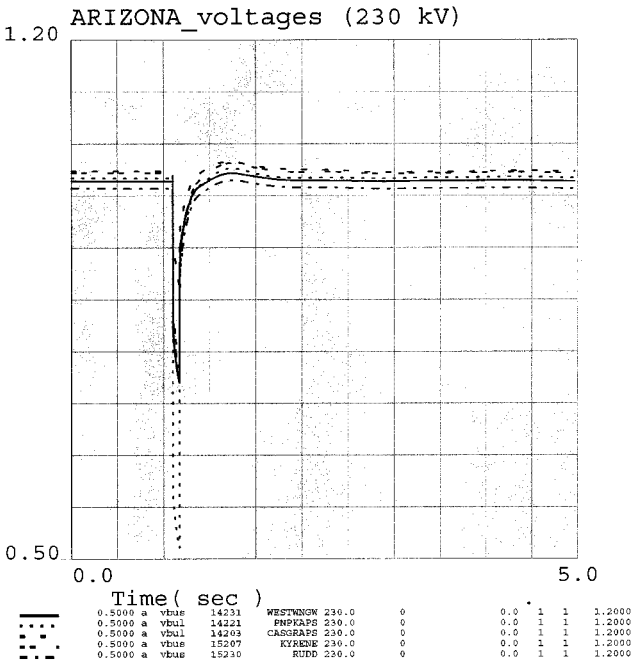

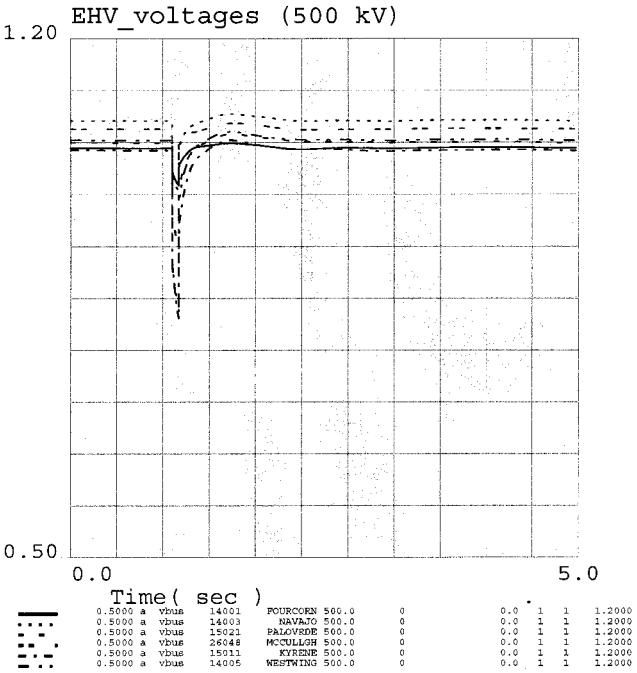

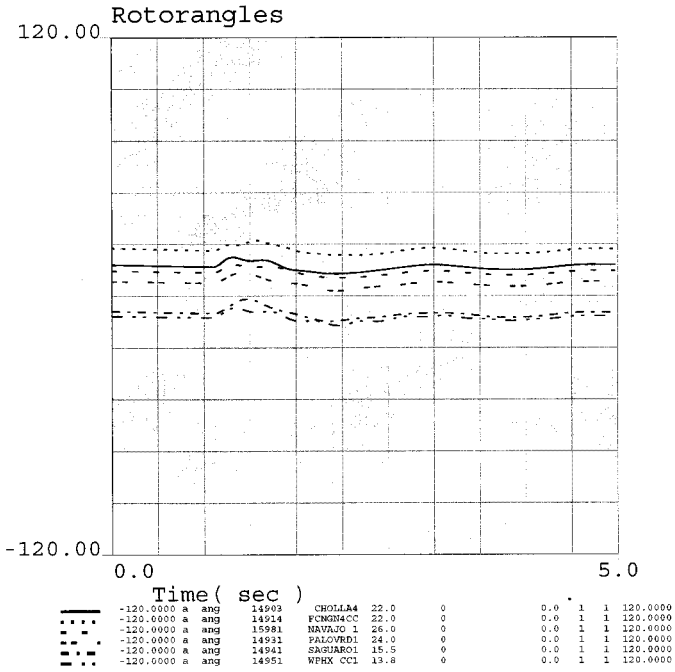

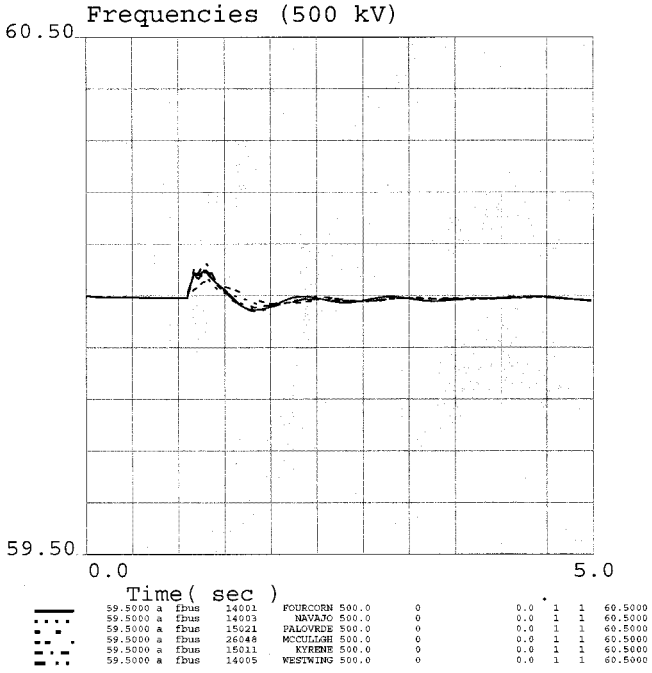

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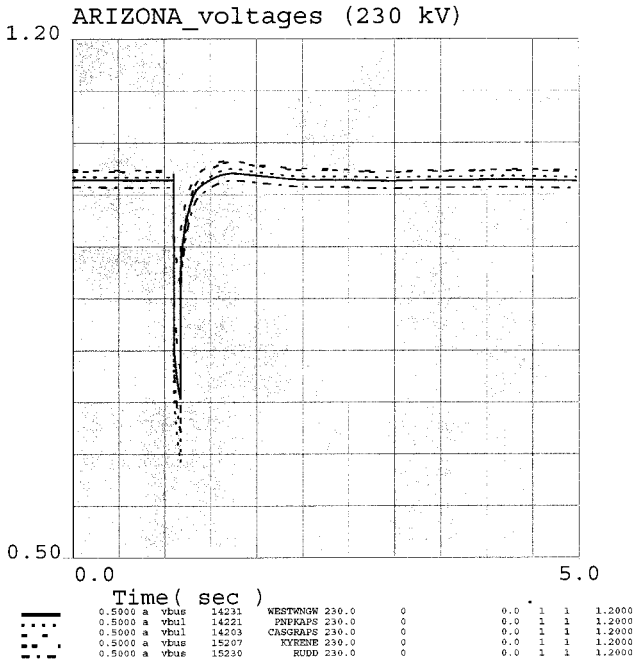

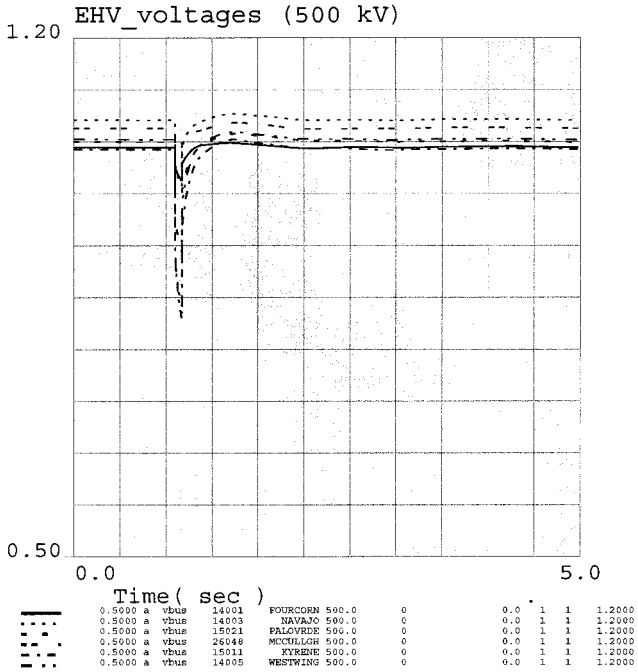

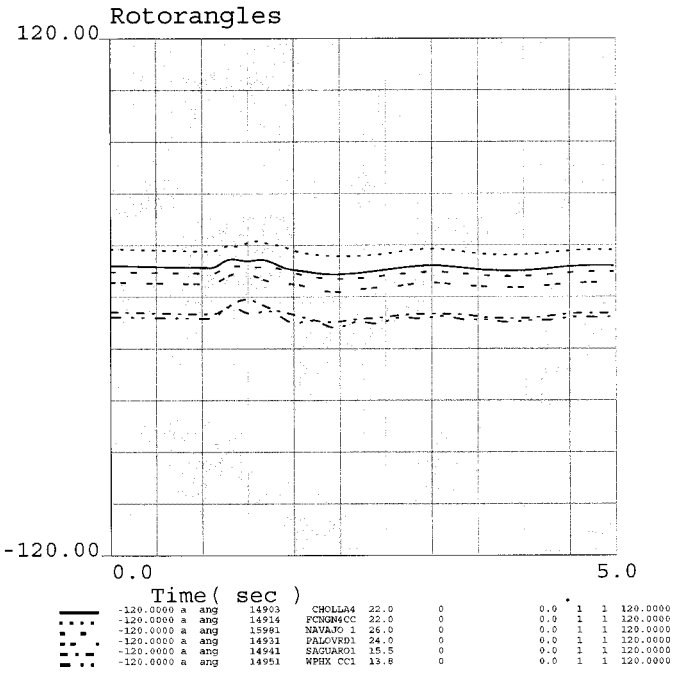

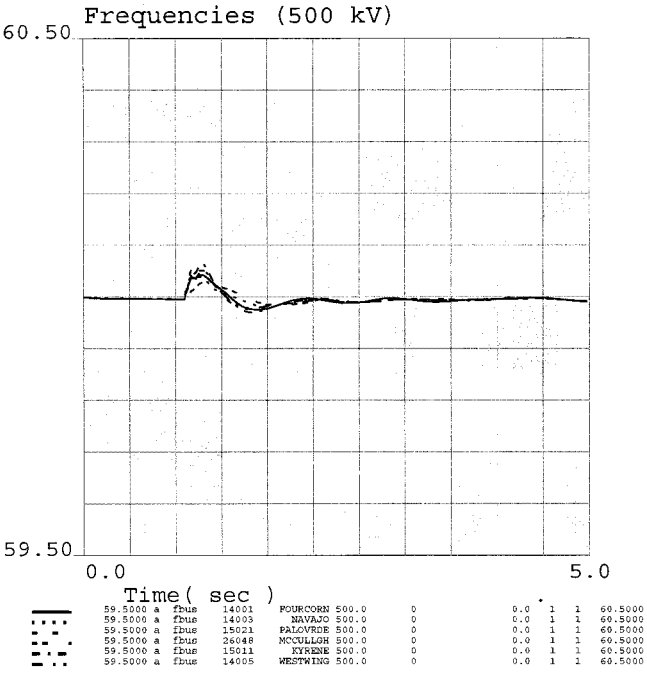

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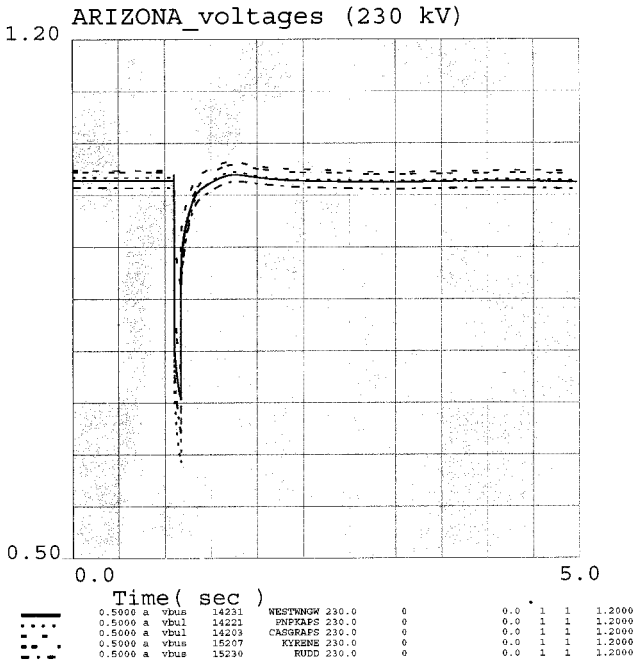

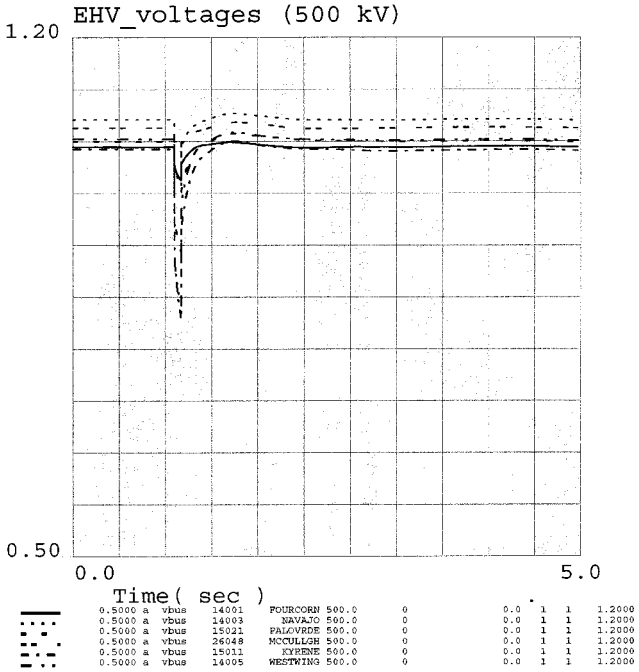

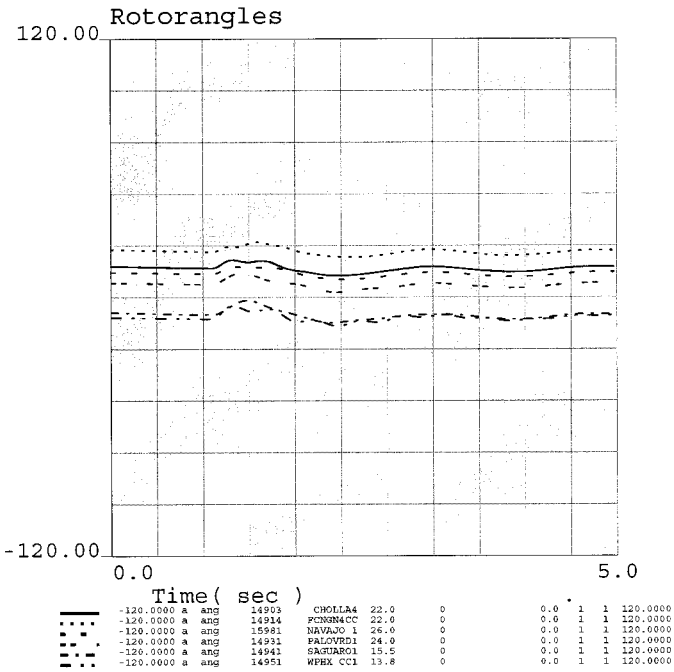

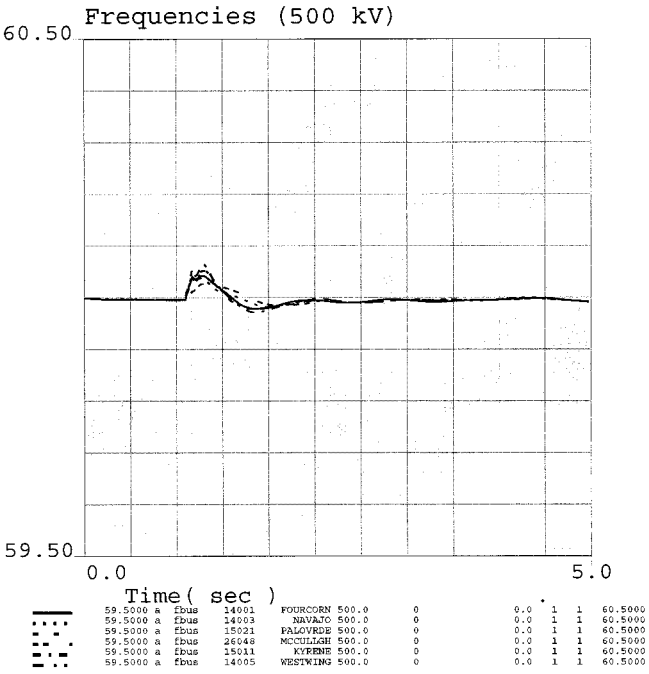

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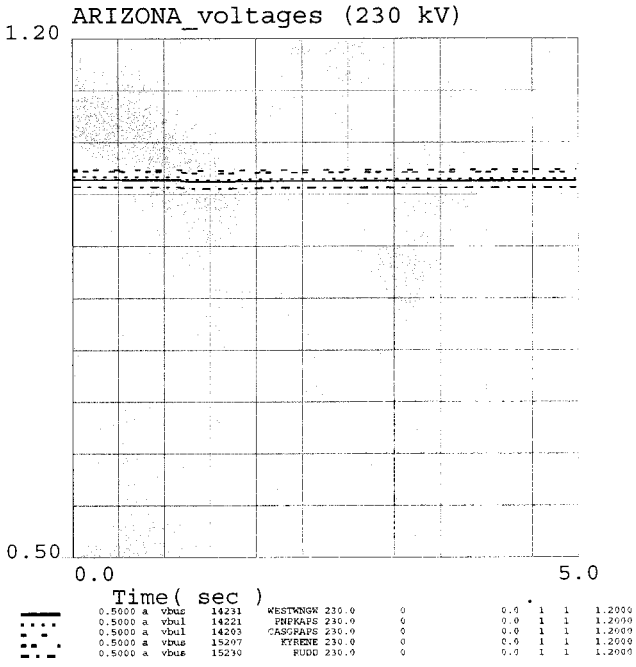

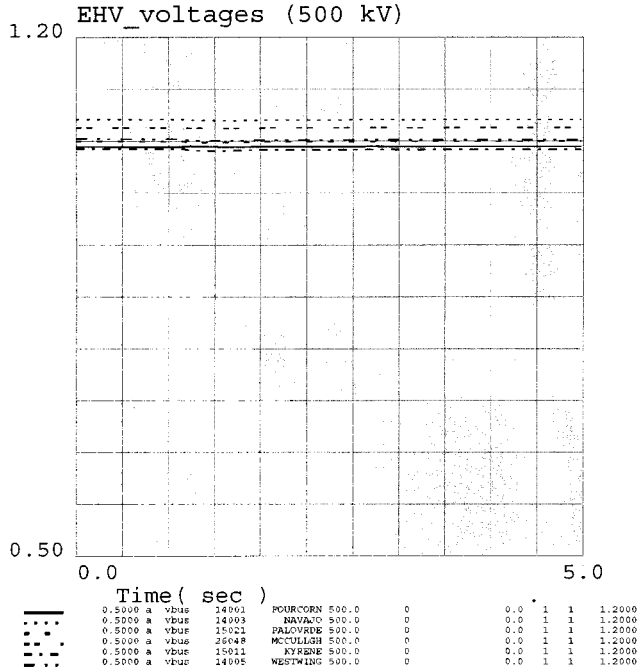

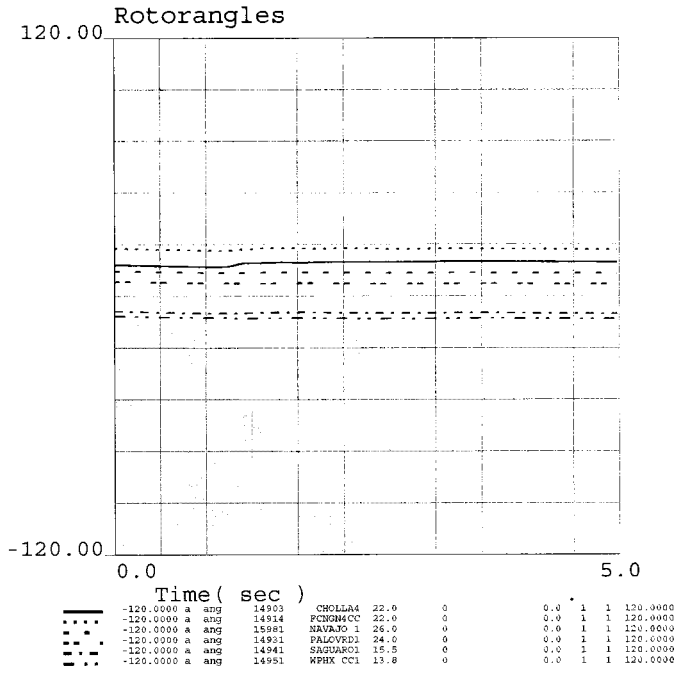

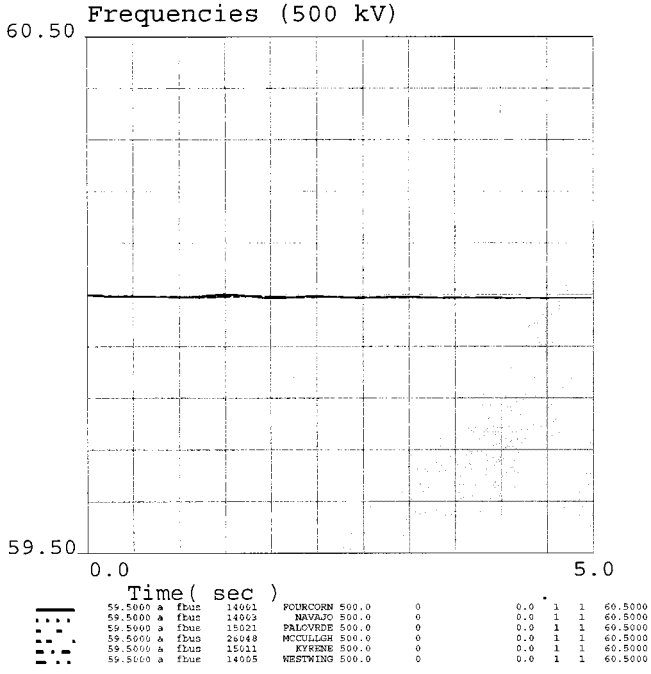

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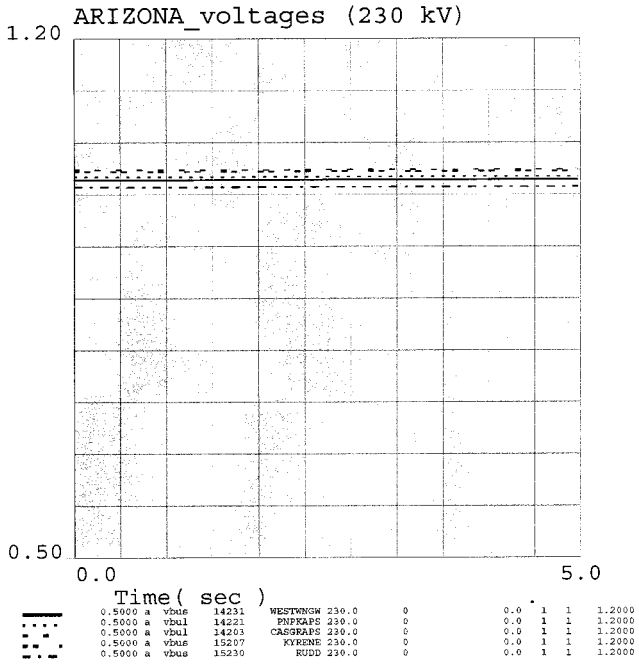

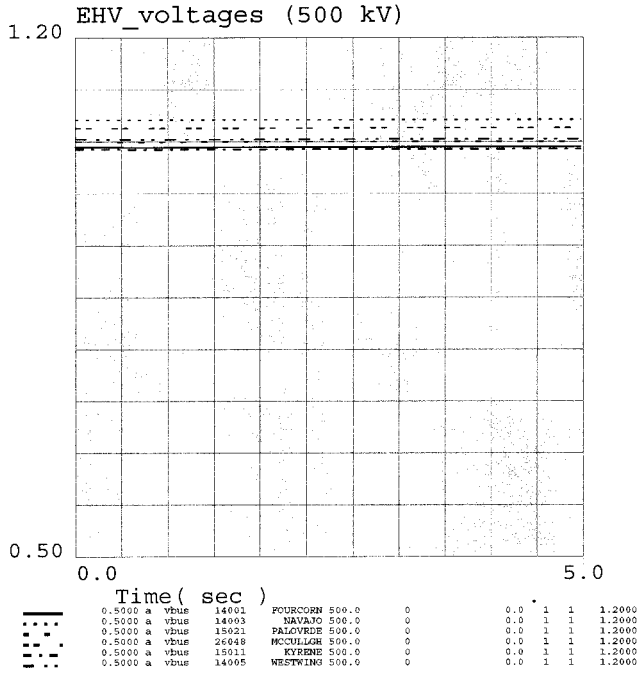

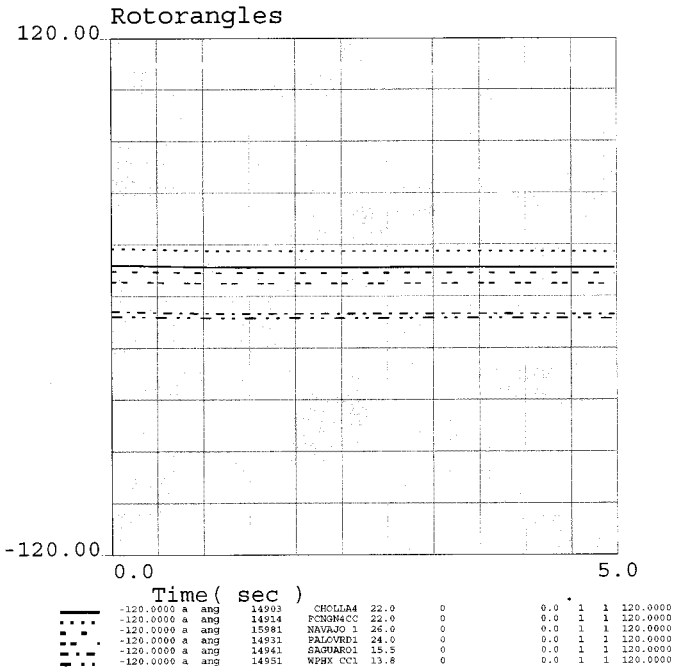

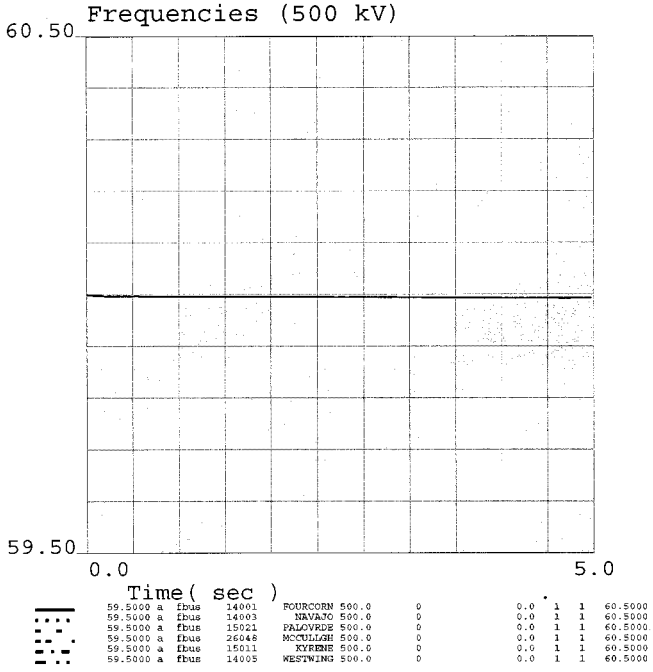

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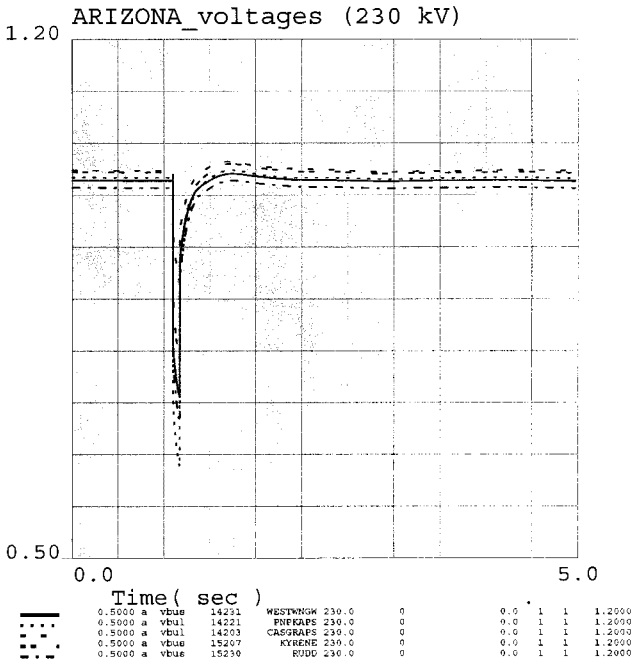

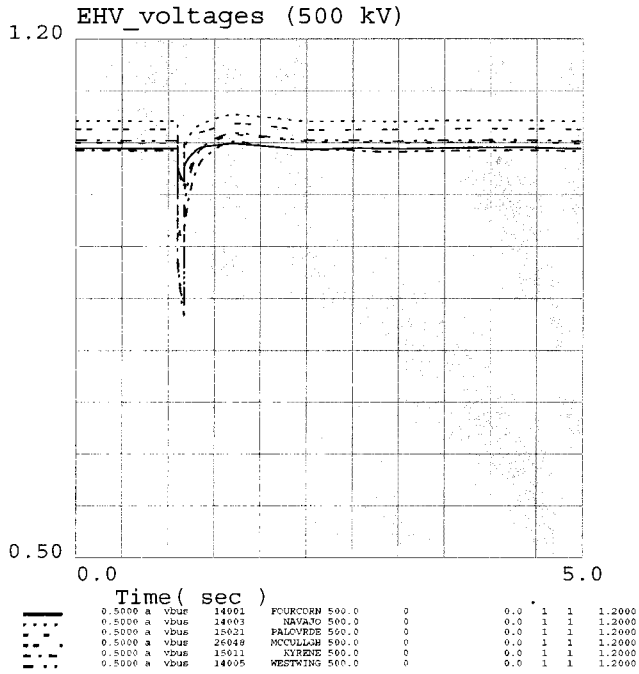

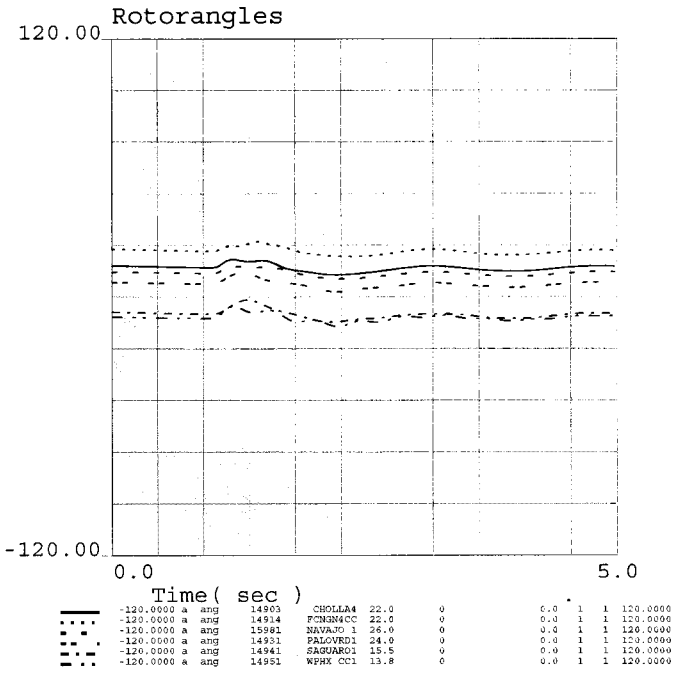

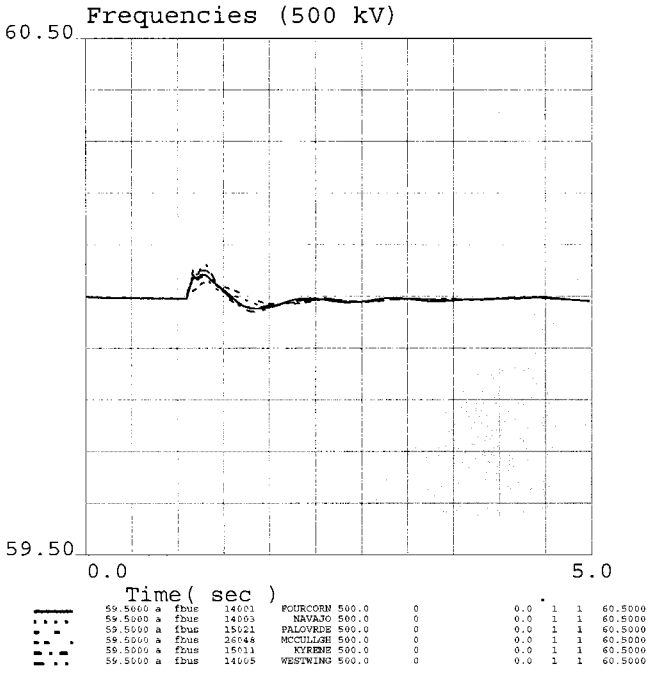

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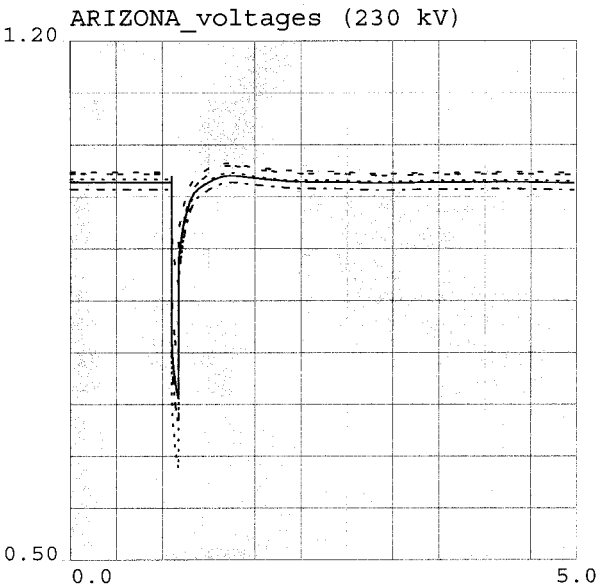
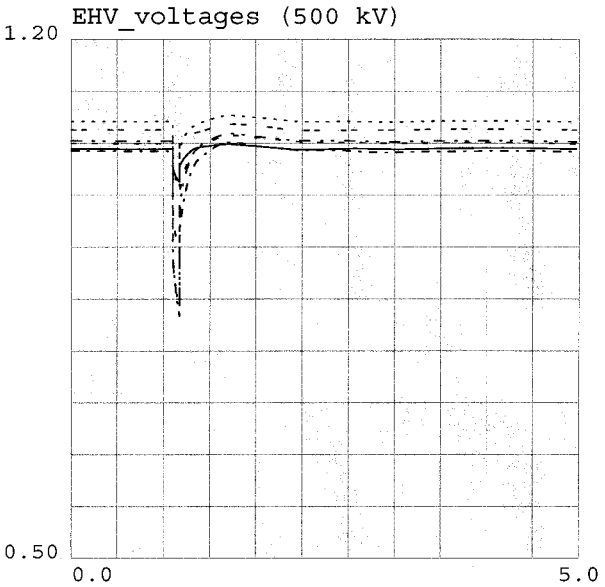
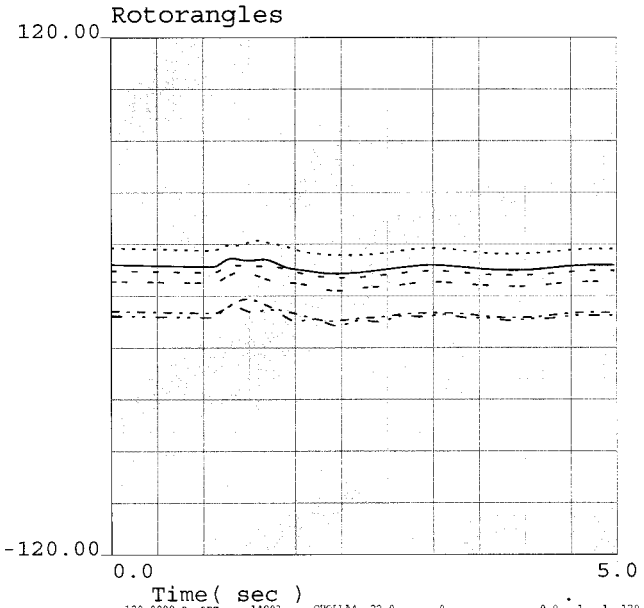


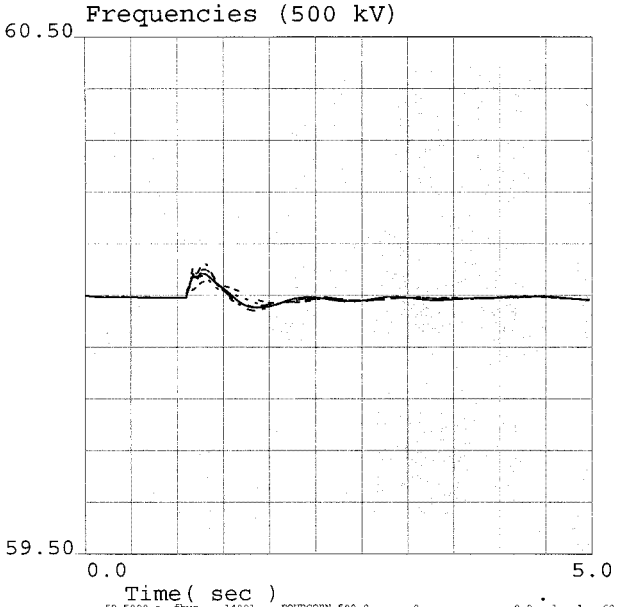
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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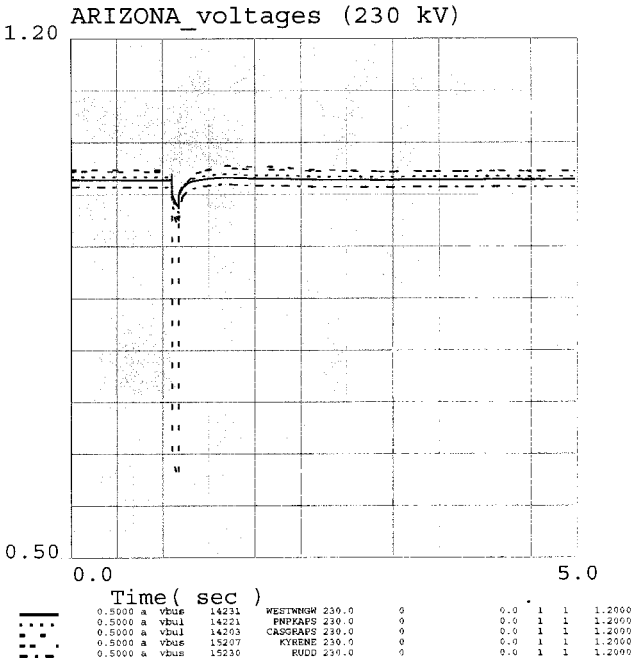

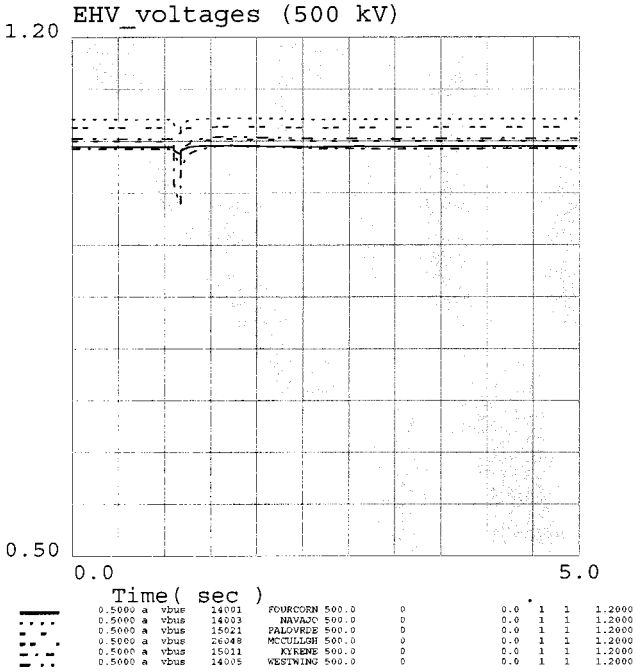

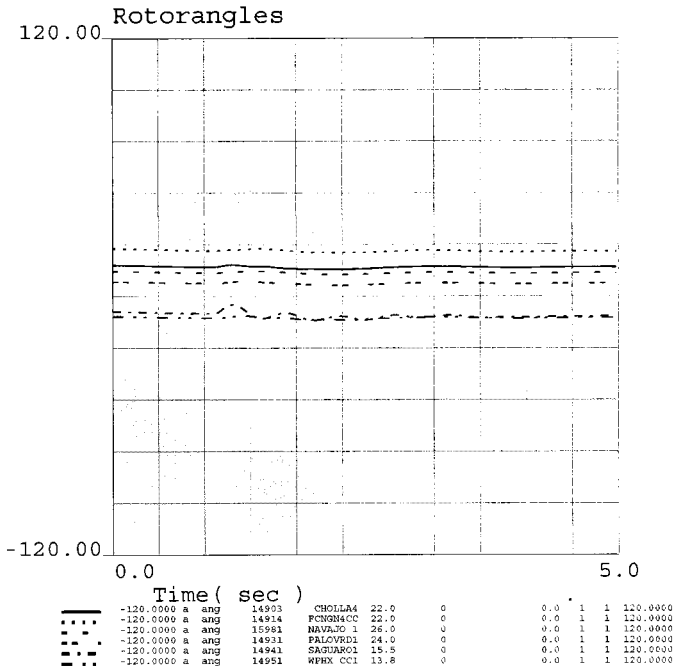

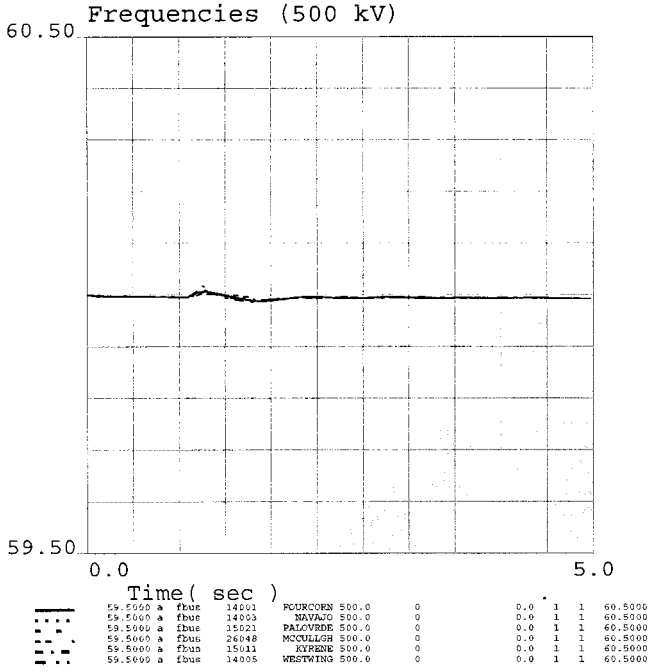

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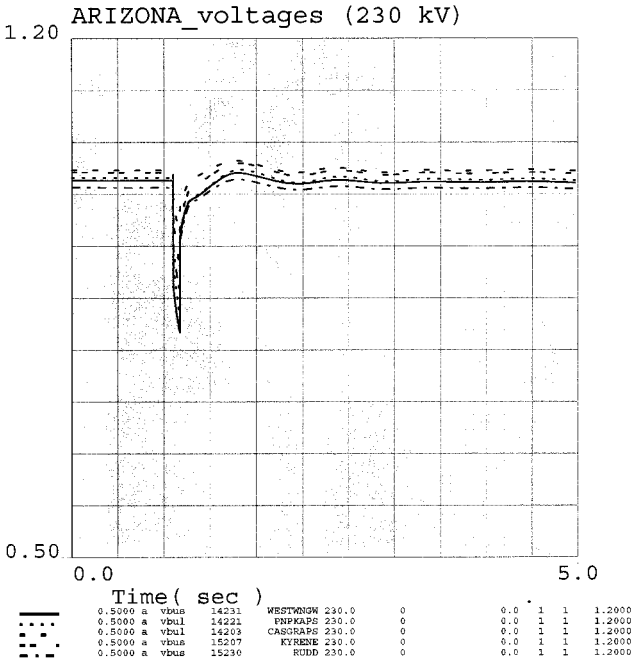

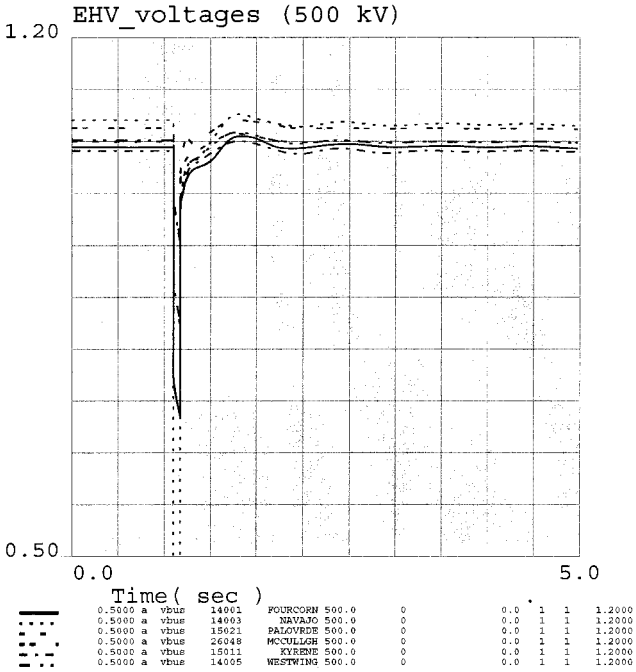

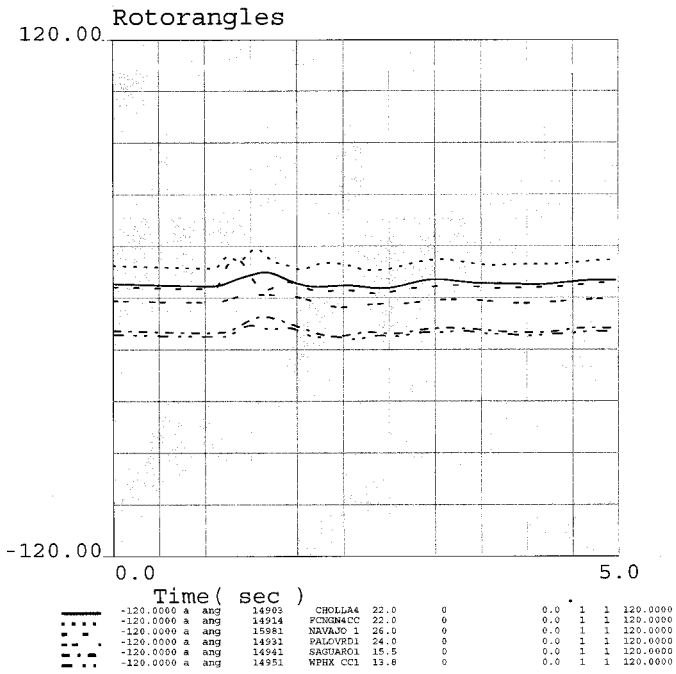

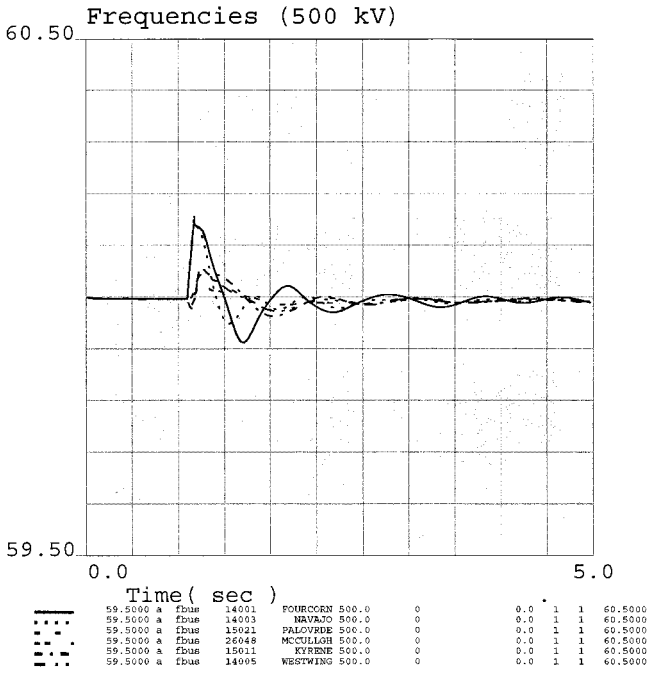

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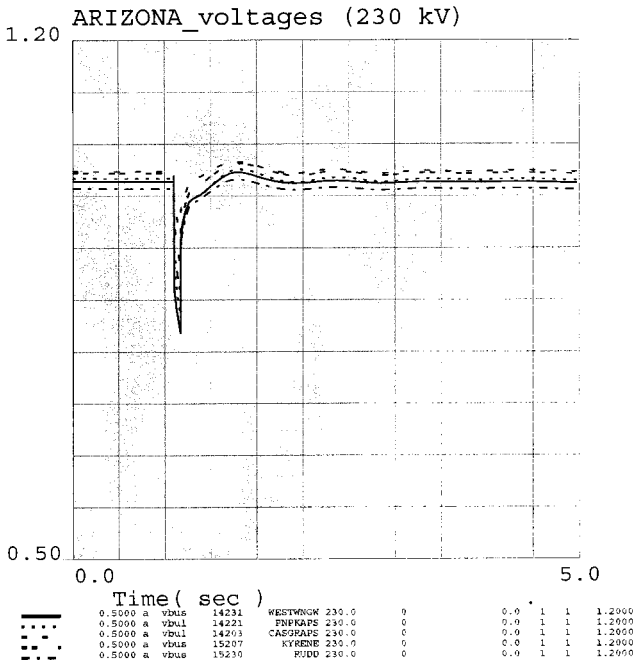

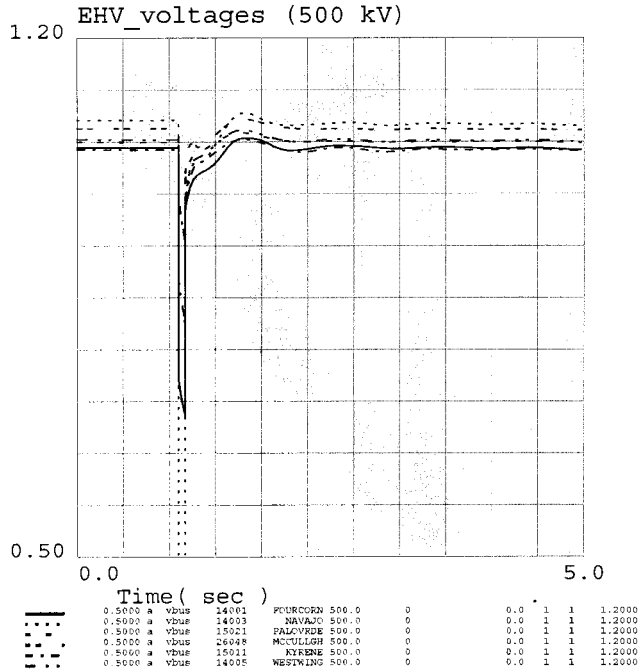

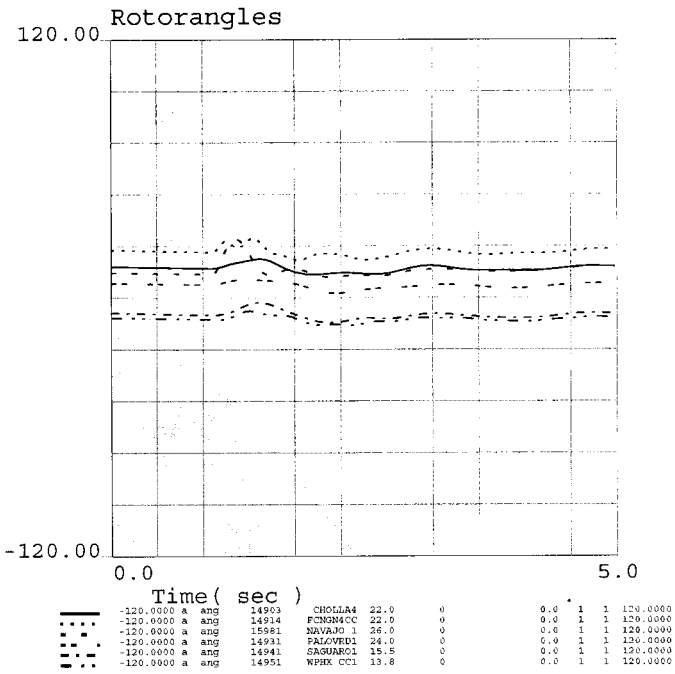

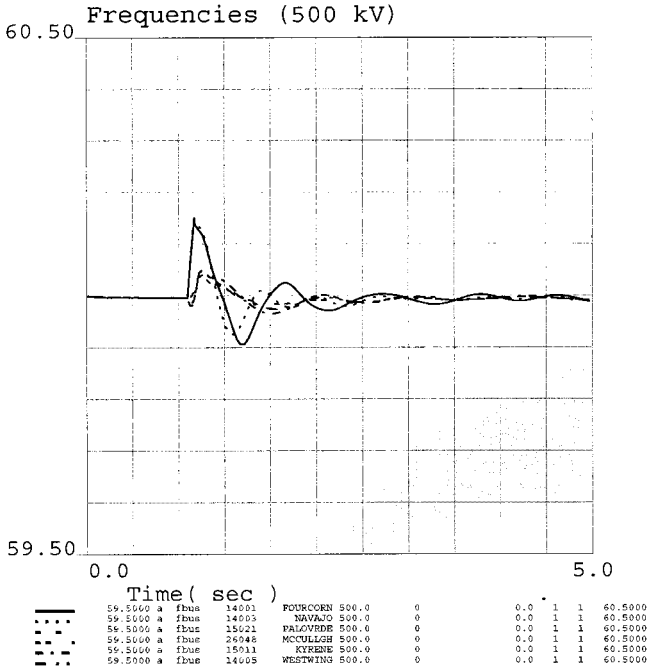

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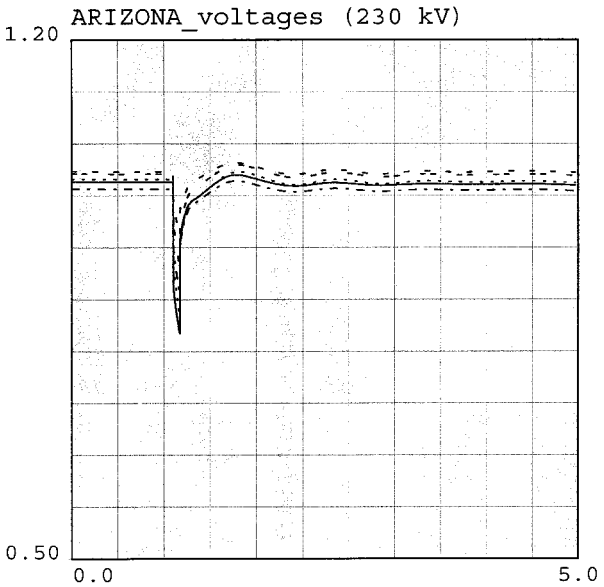

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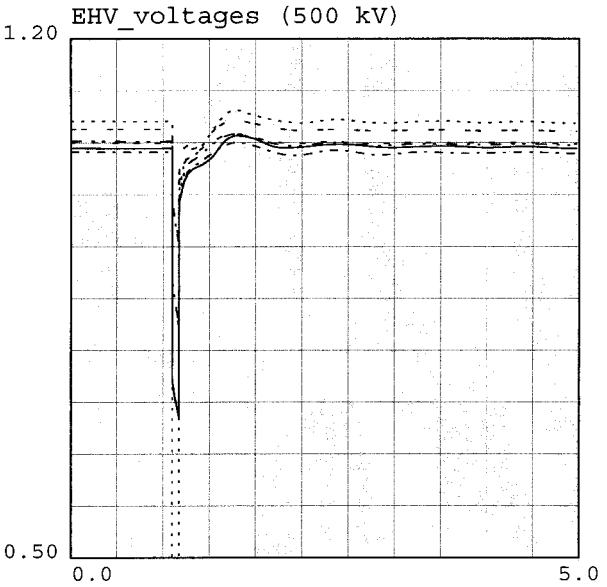
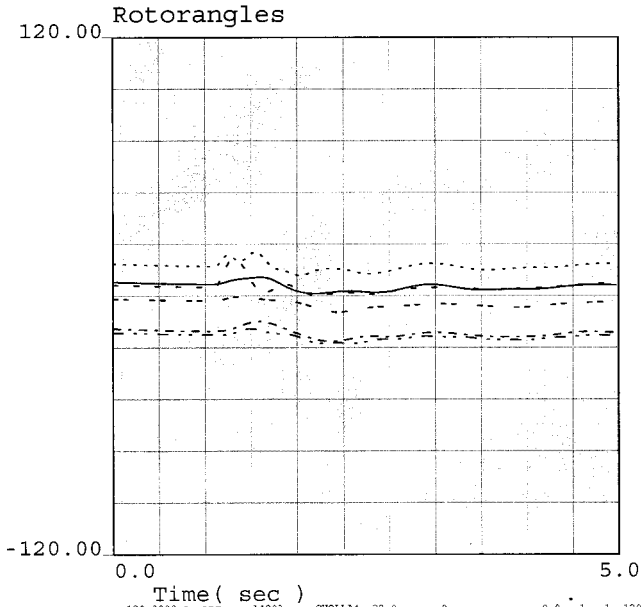
0.5000 a	vbul	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbul	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000 a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000 a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
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-120.0000 a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	18.5	0	0.0	1	1	120.0000
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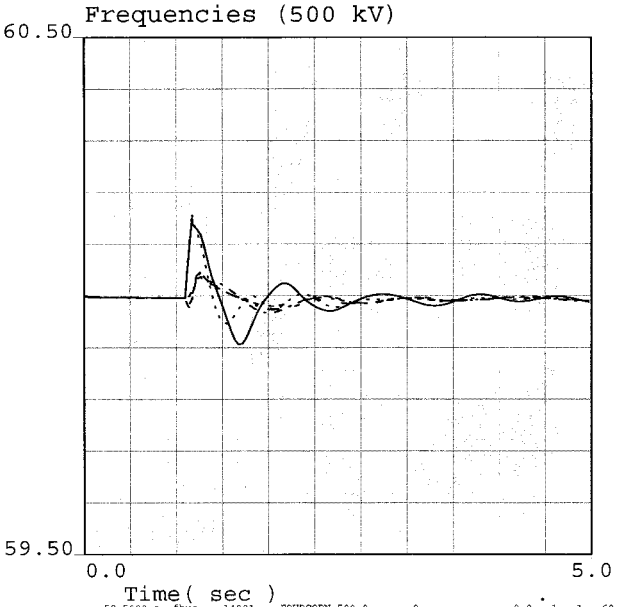

59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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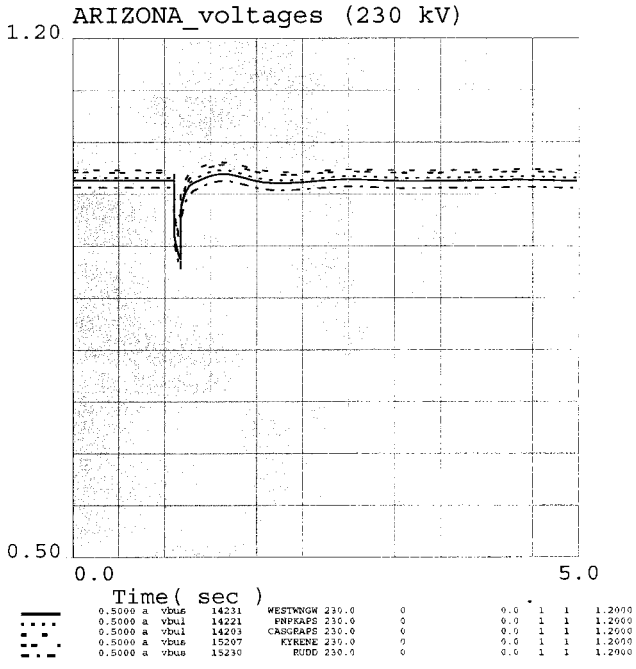

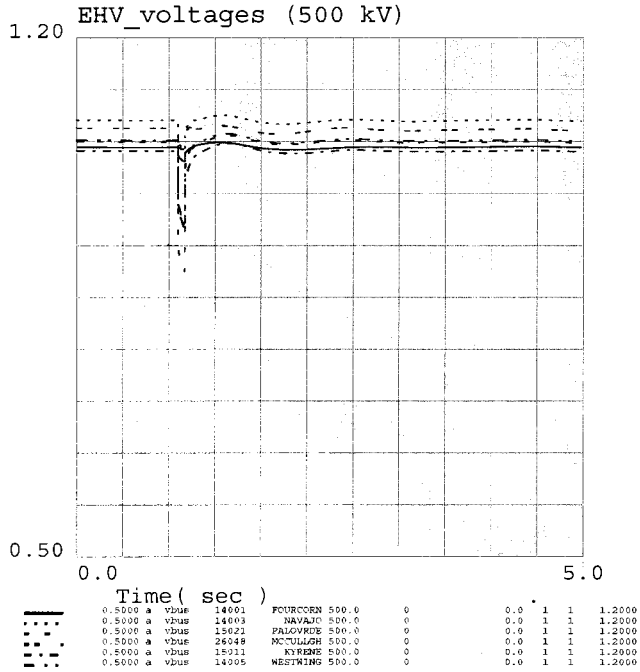

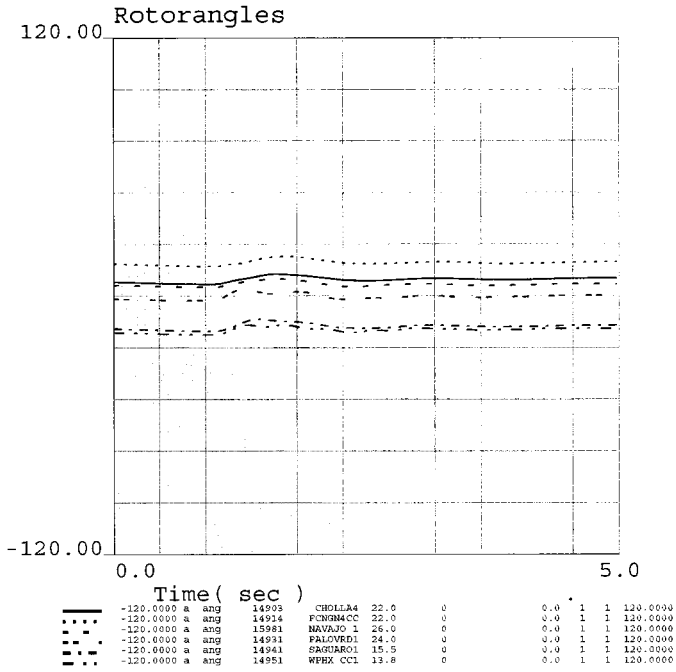

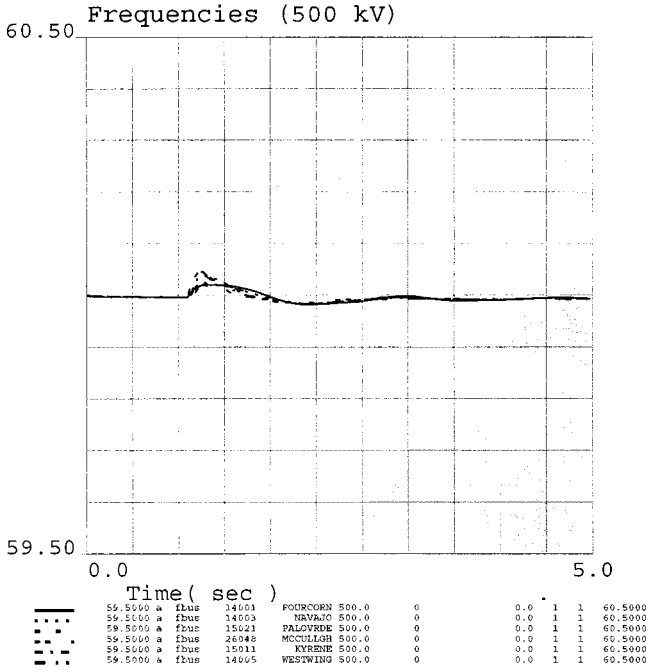

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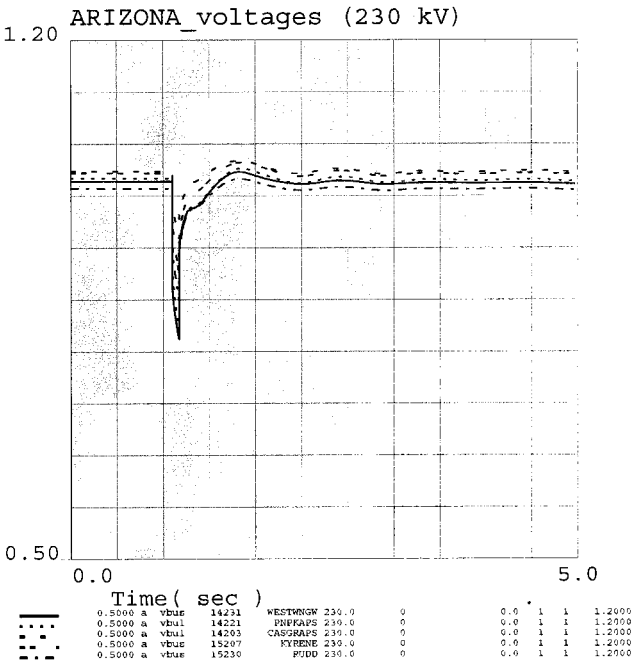

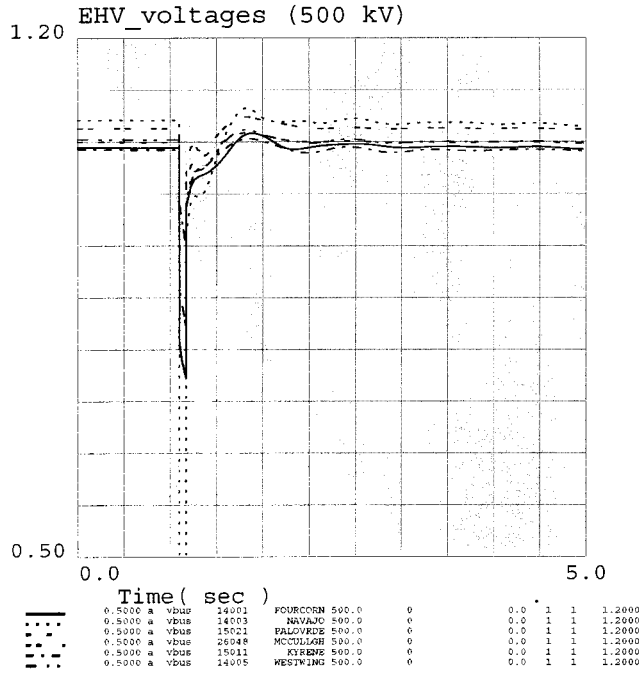

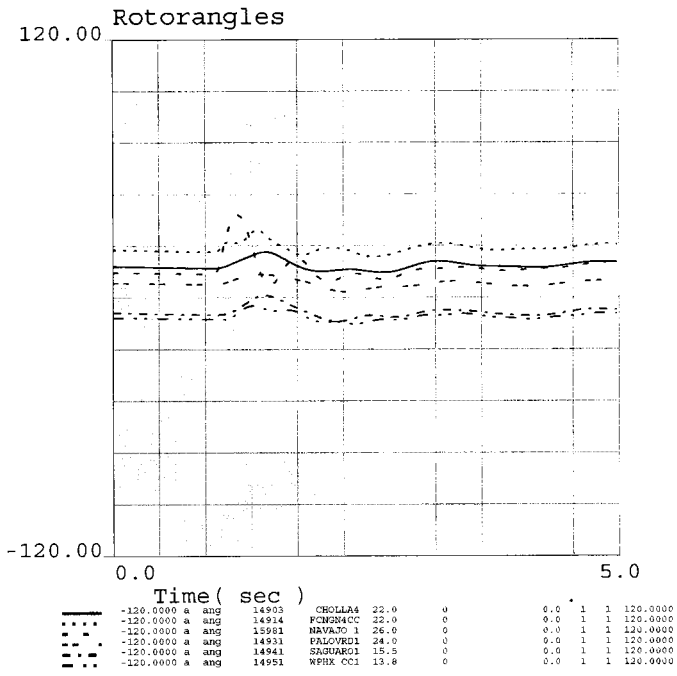

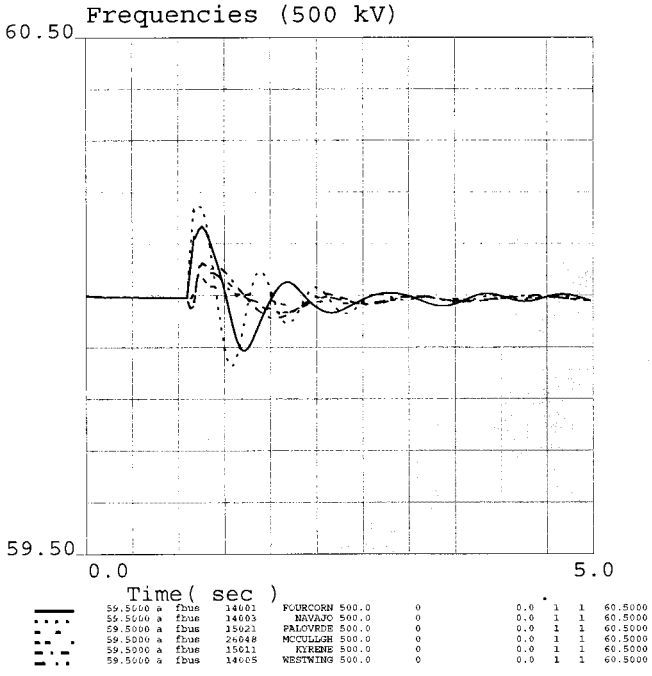

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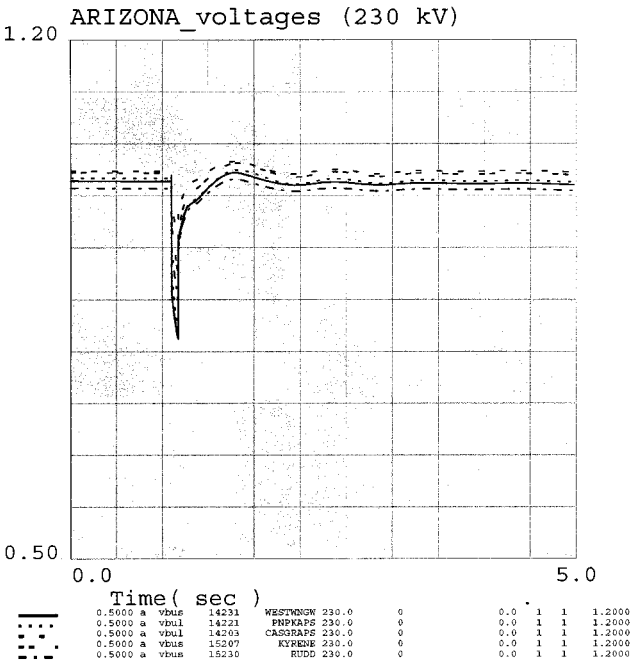

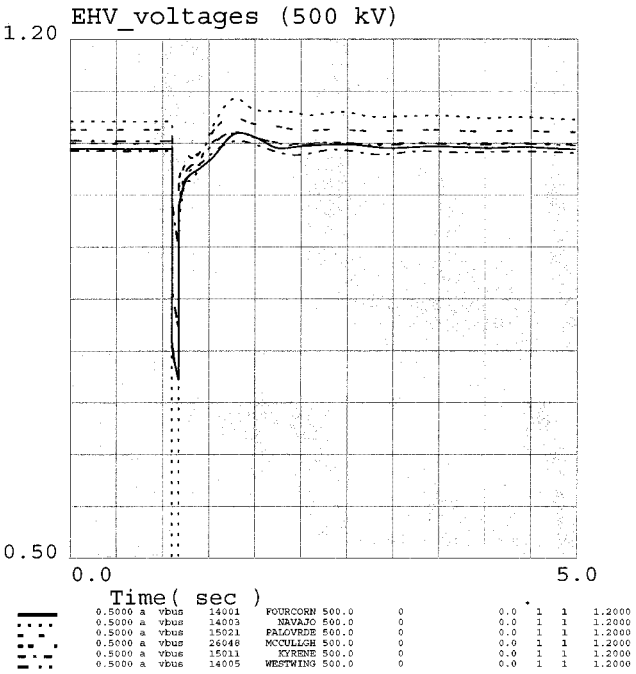

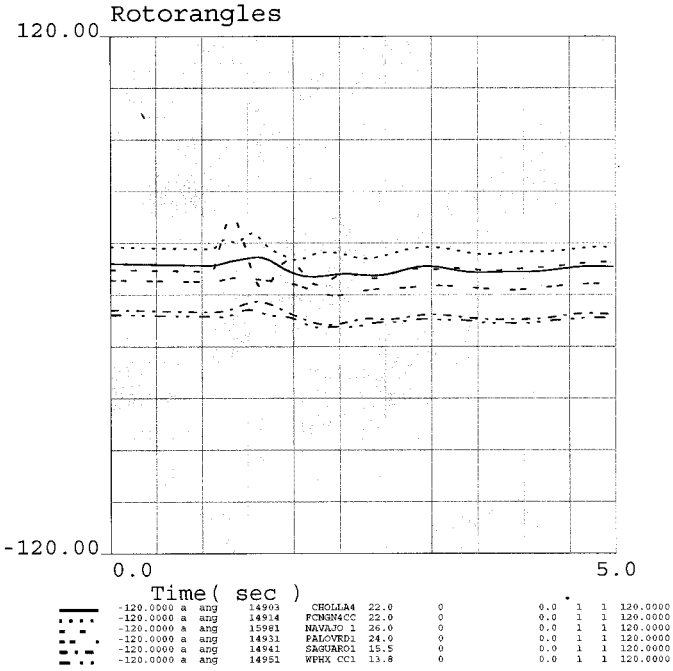

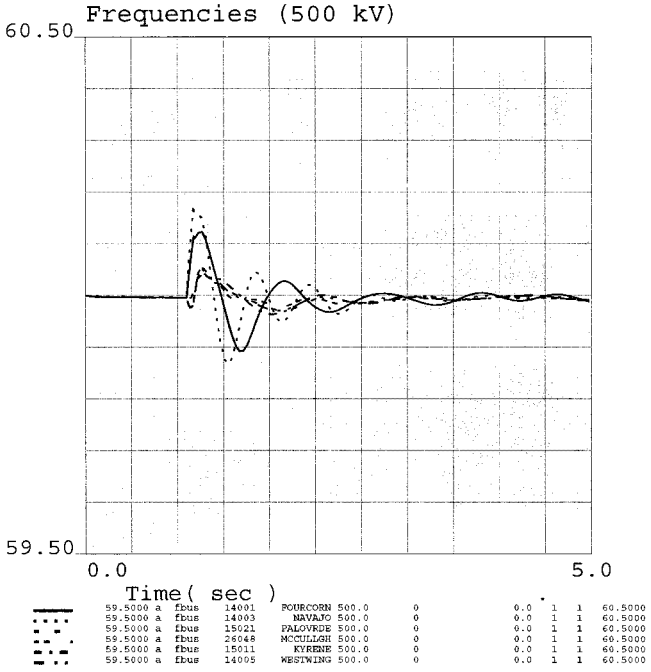

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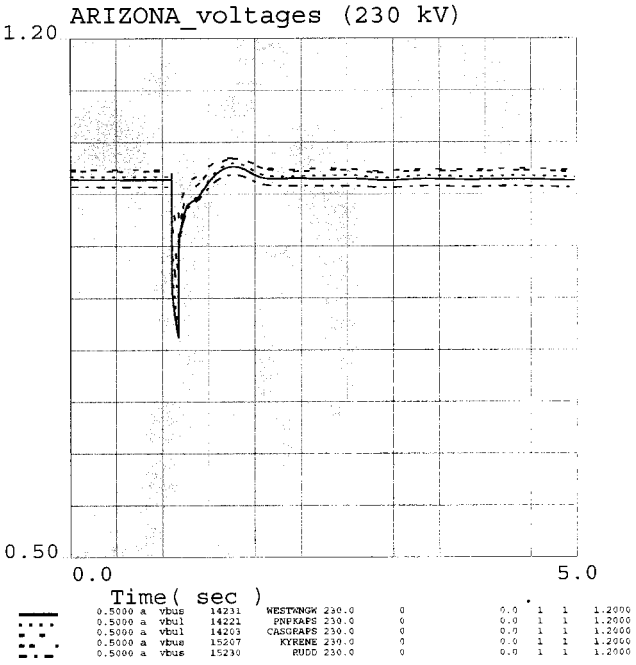

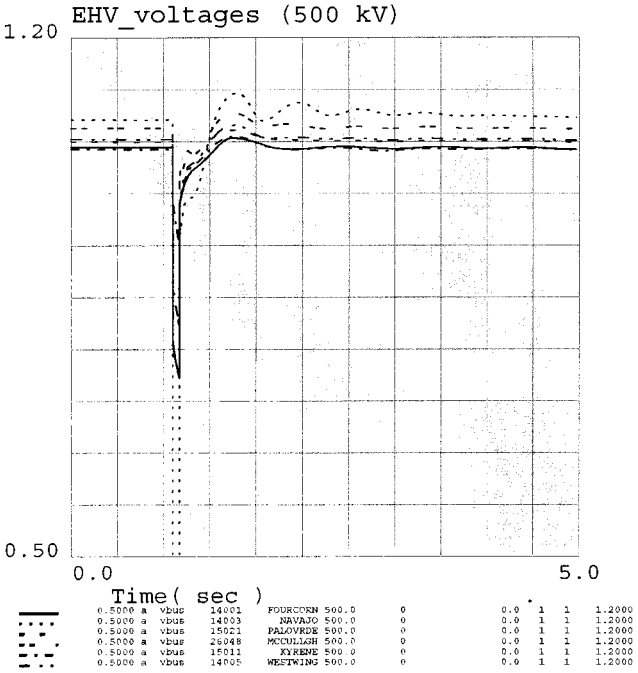

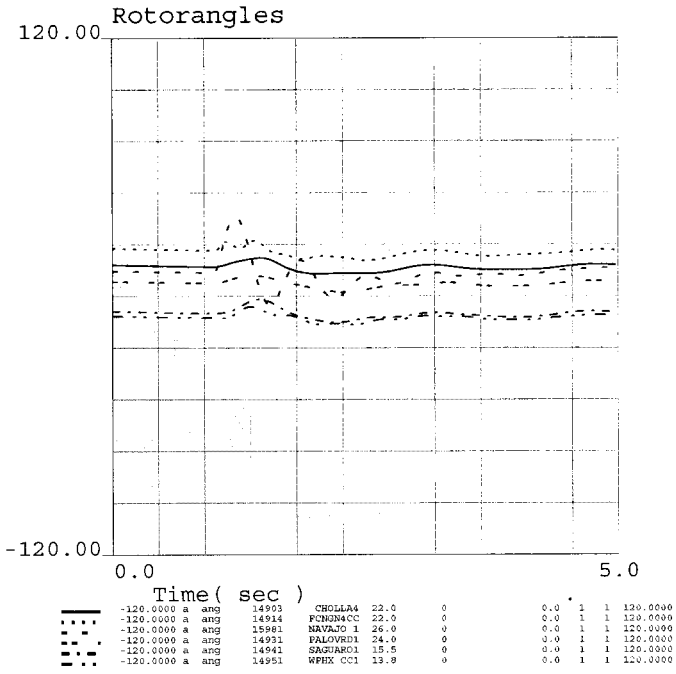

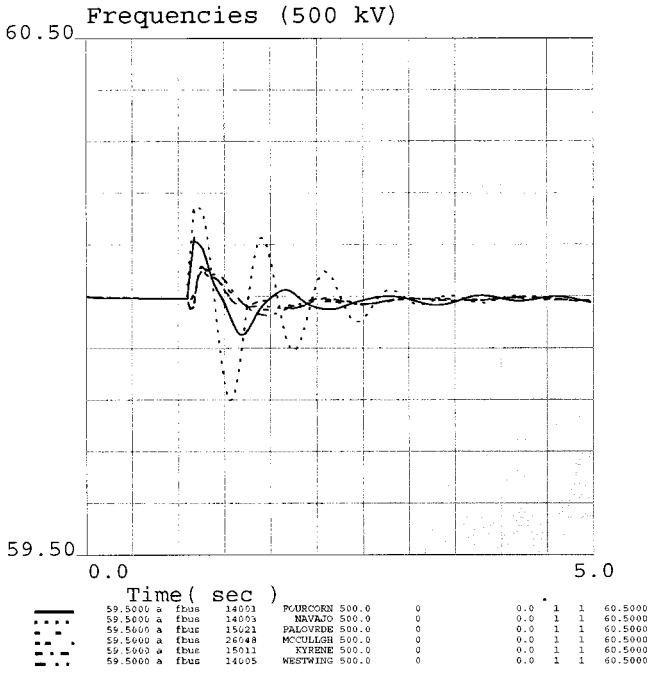

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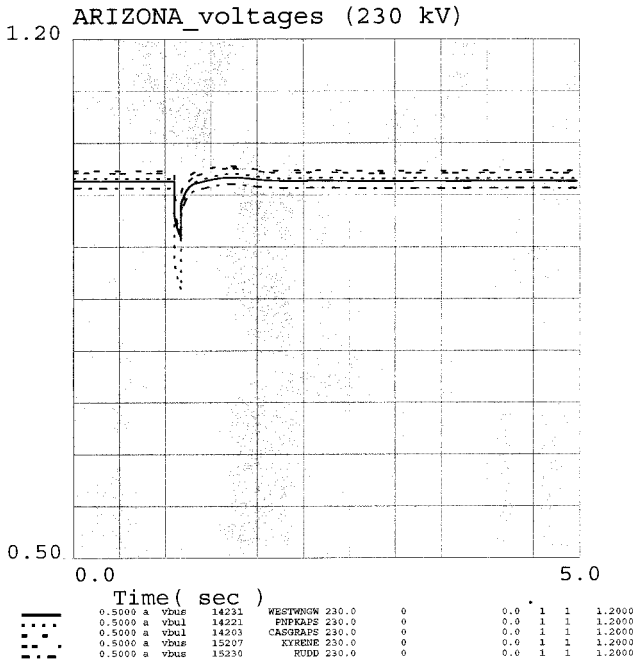

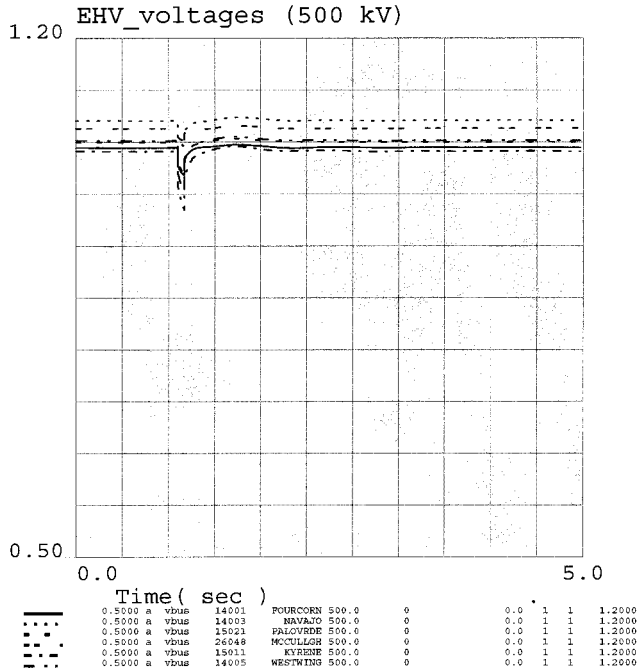

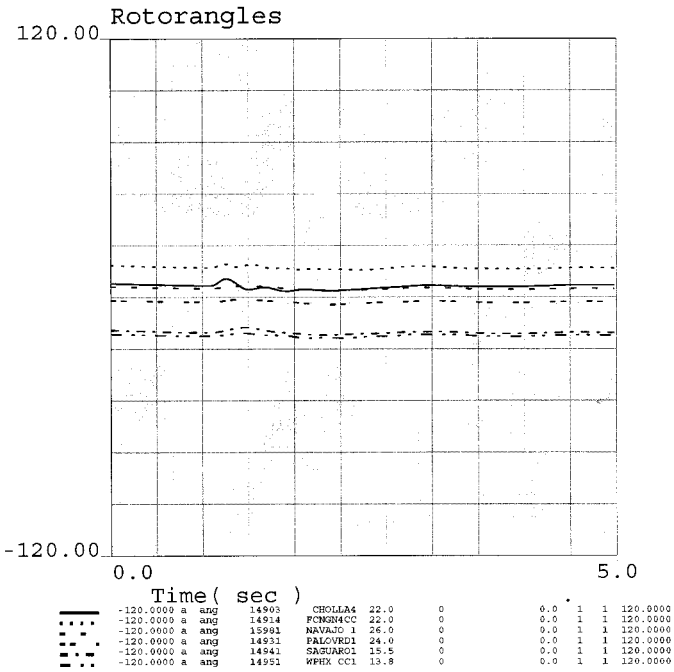

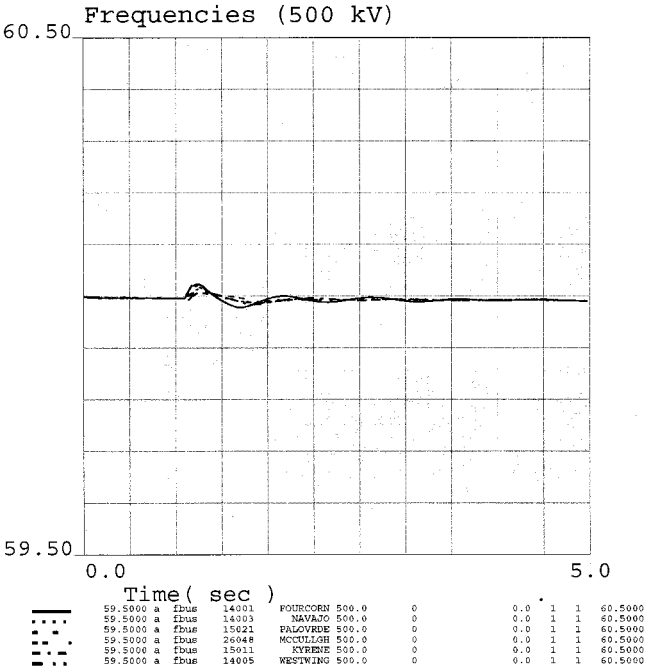

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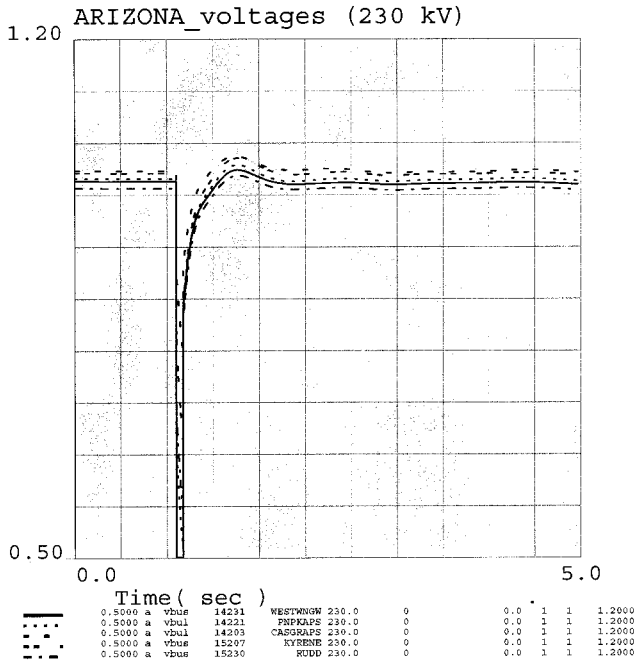

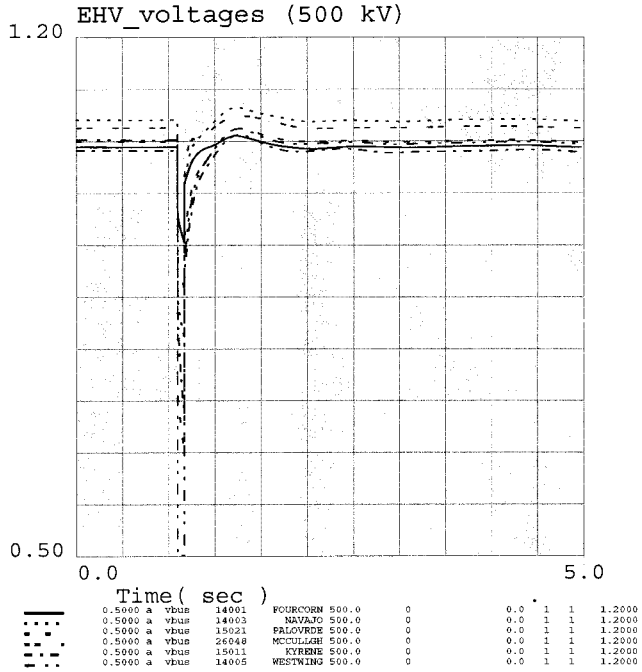

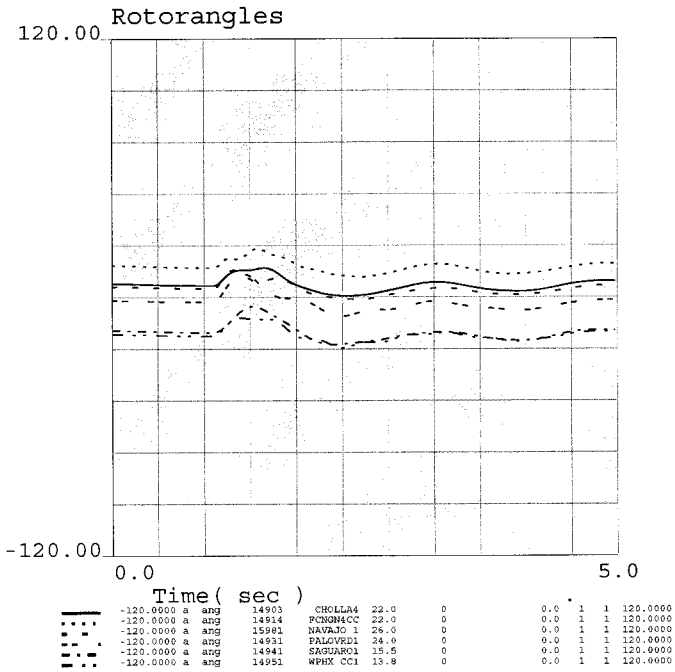

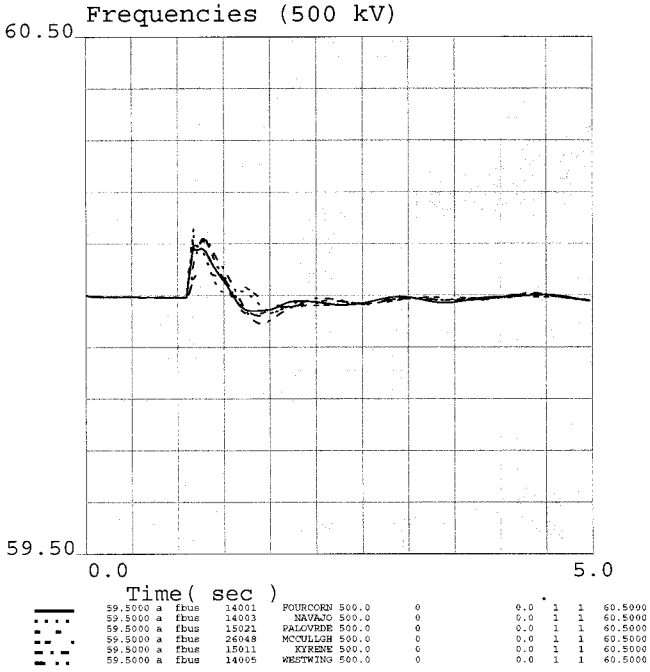

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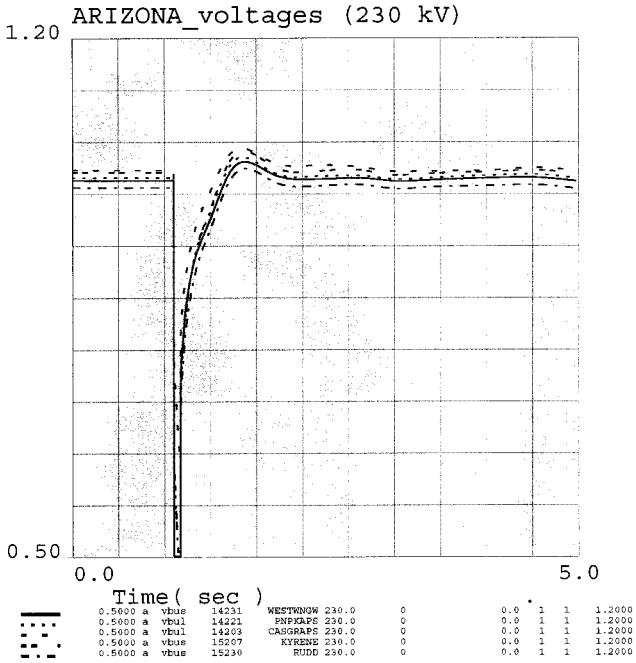

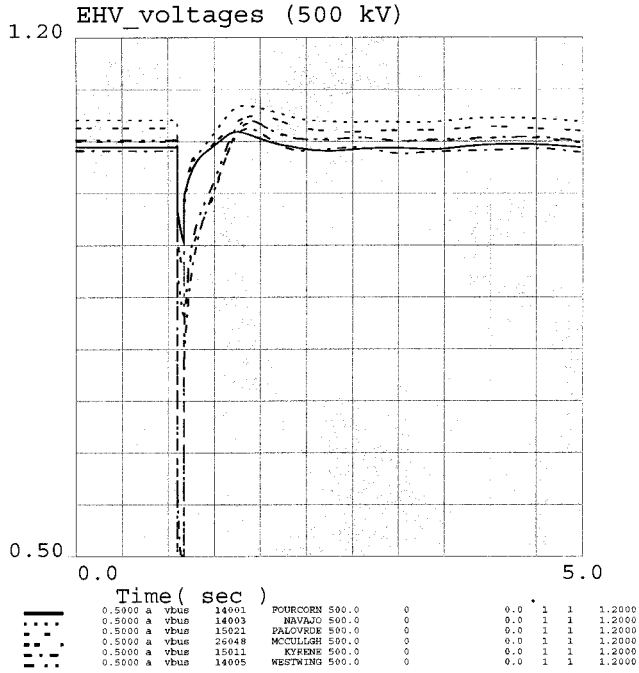

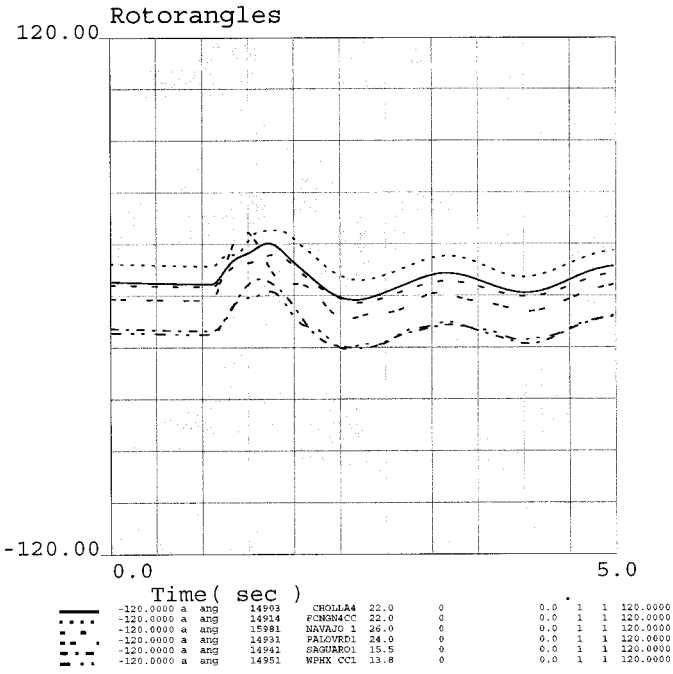

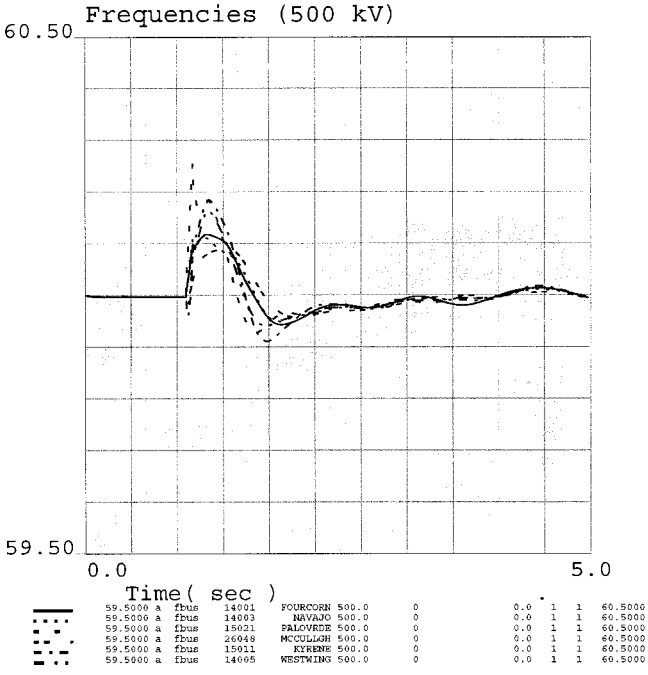

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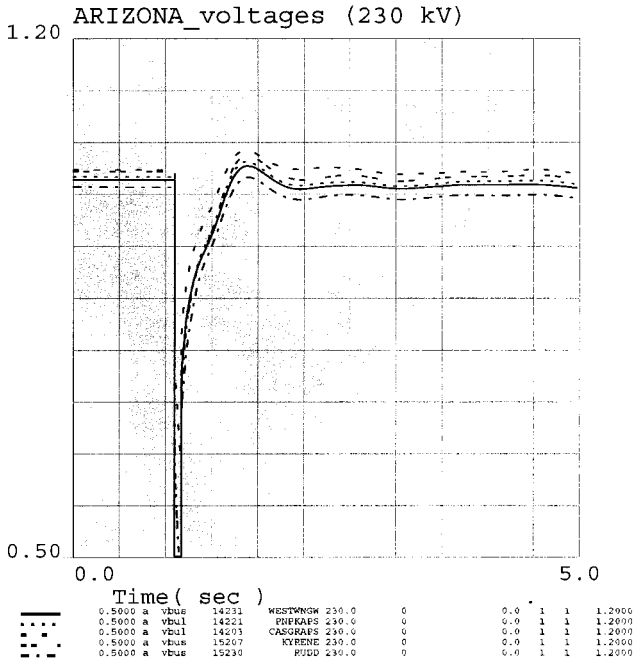

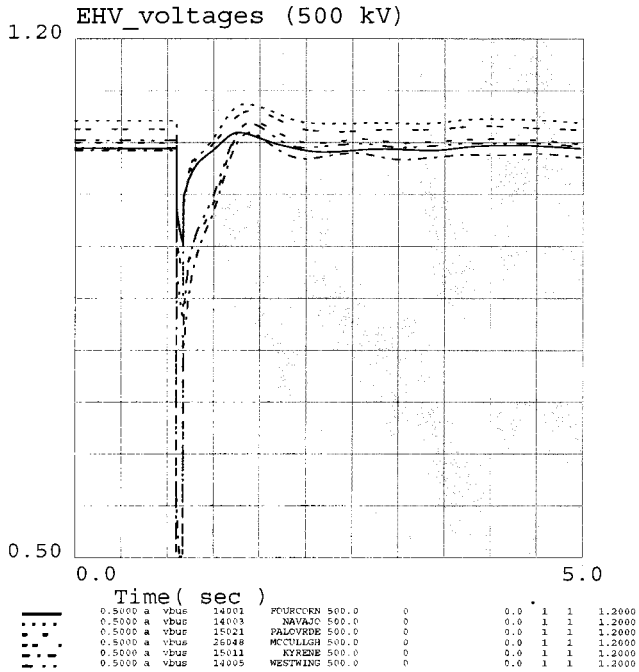

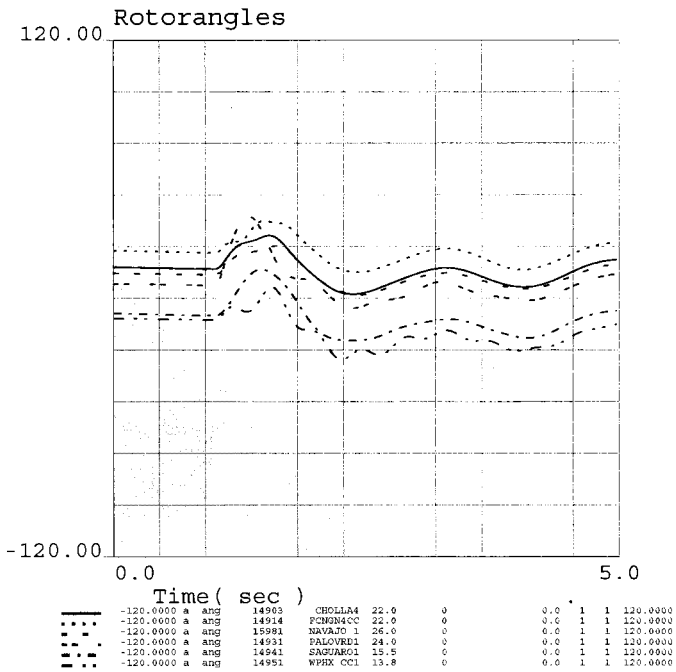

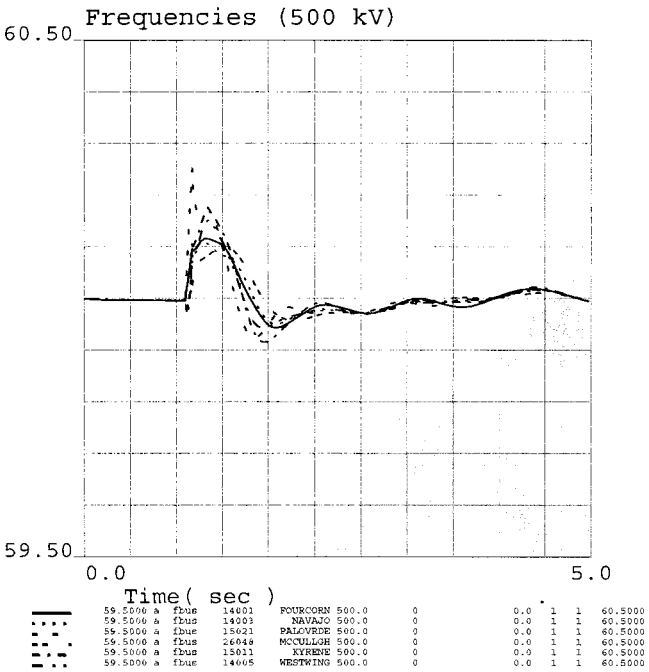

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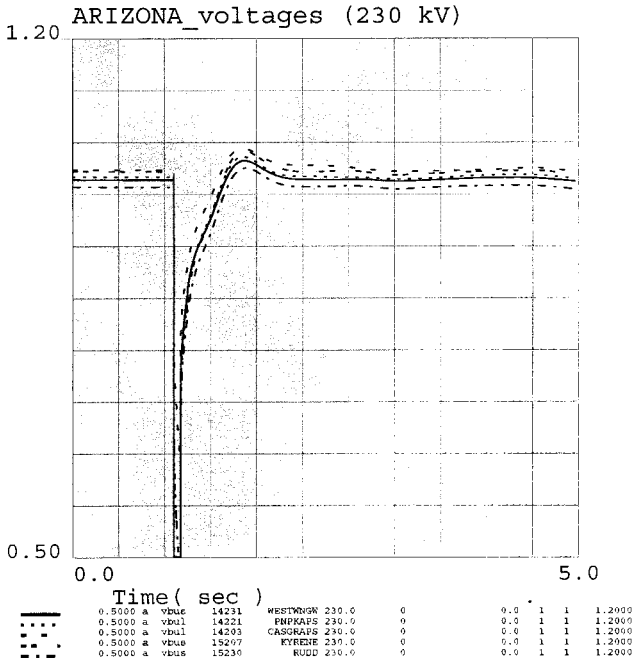

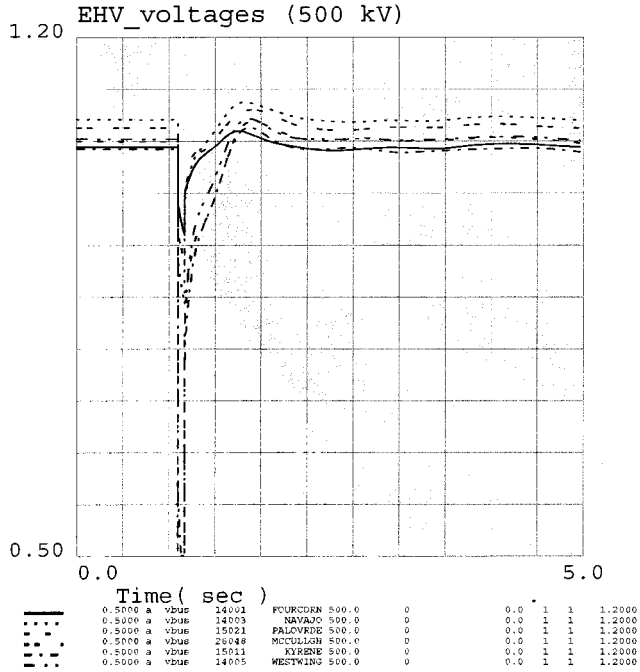

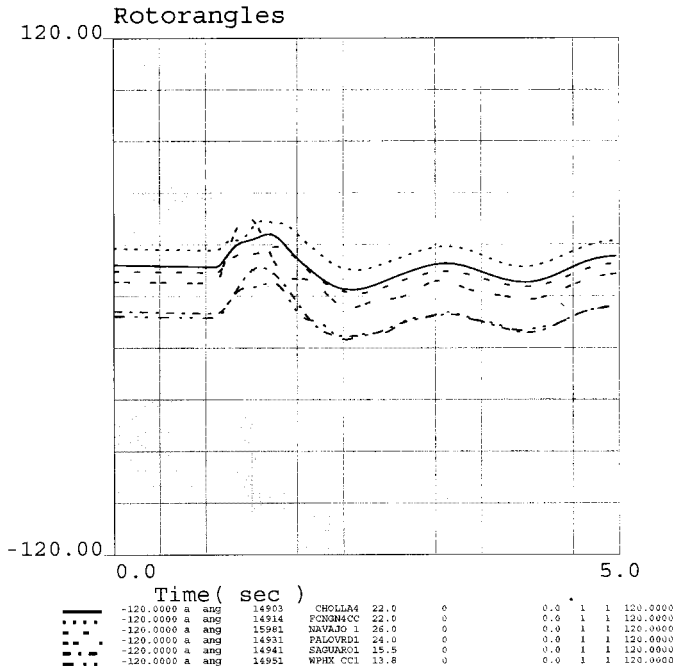

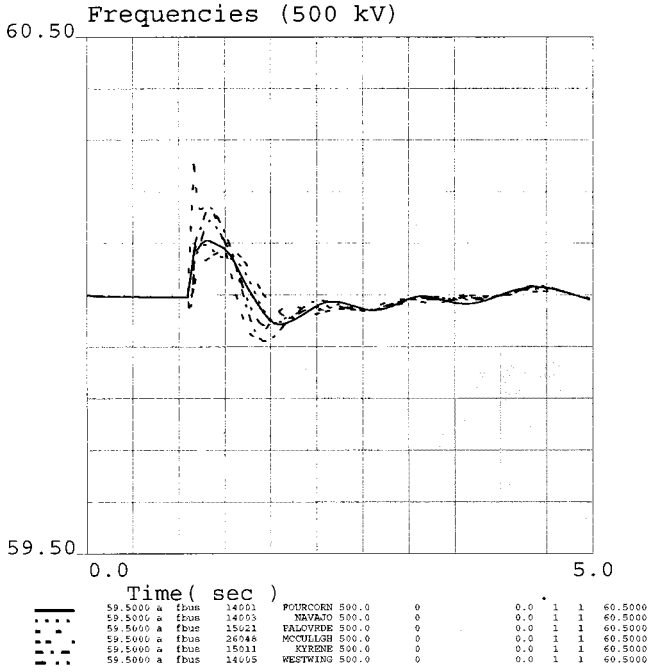

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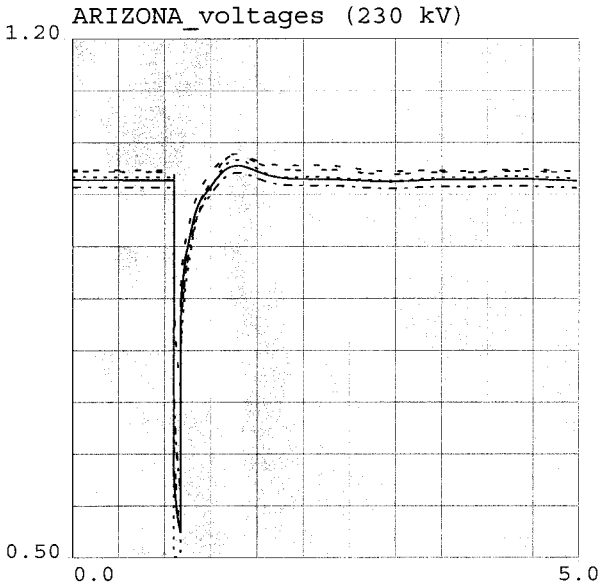

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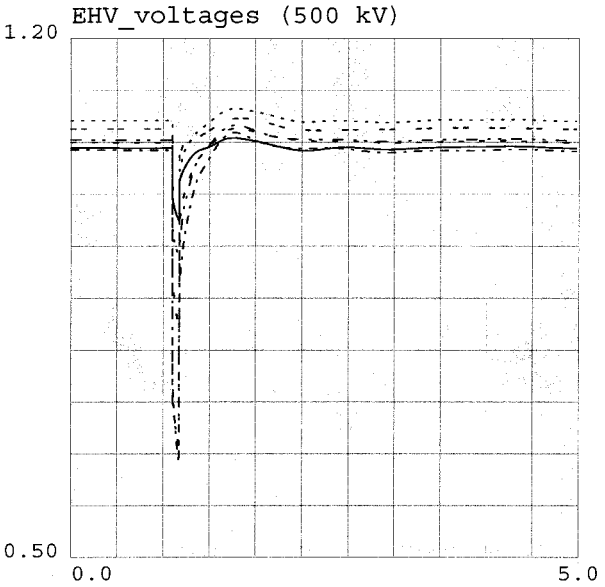
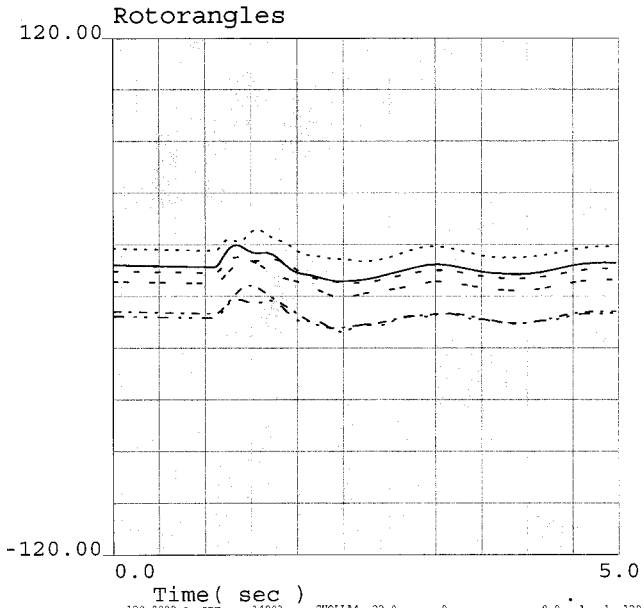
0.5000	a	vbus	14221	PHPXAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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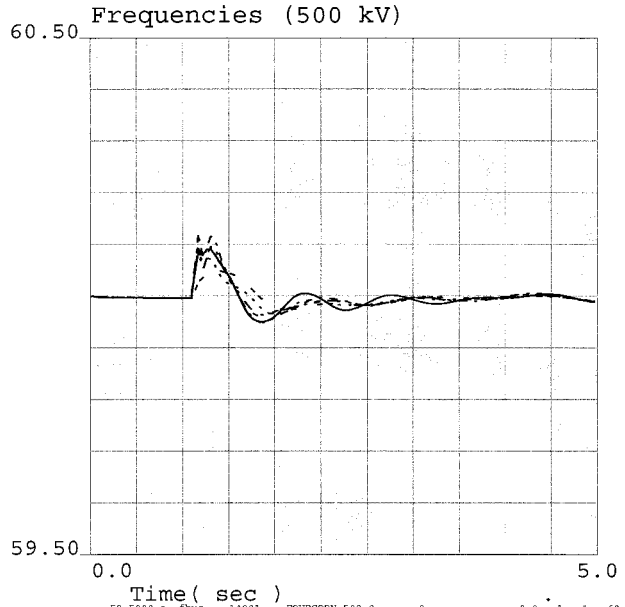

59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
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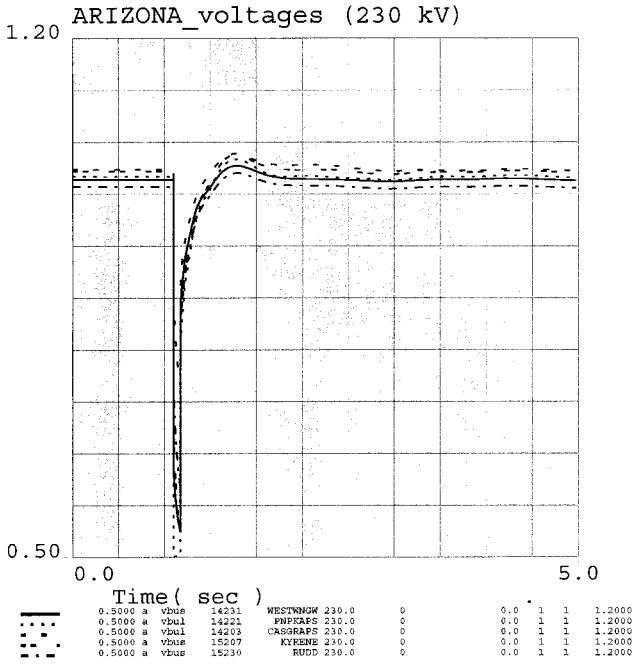

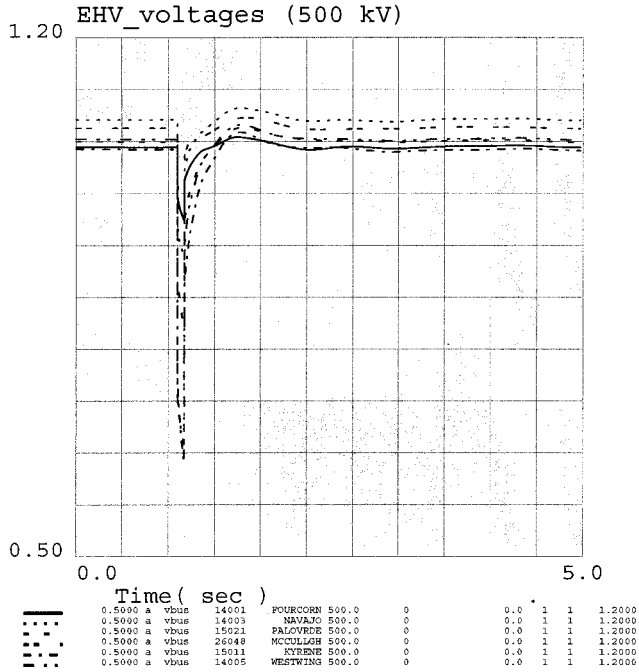

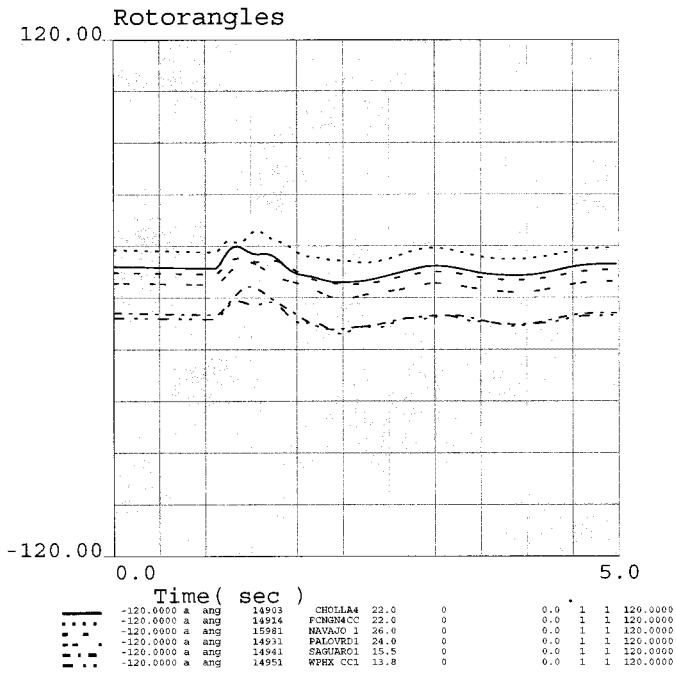

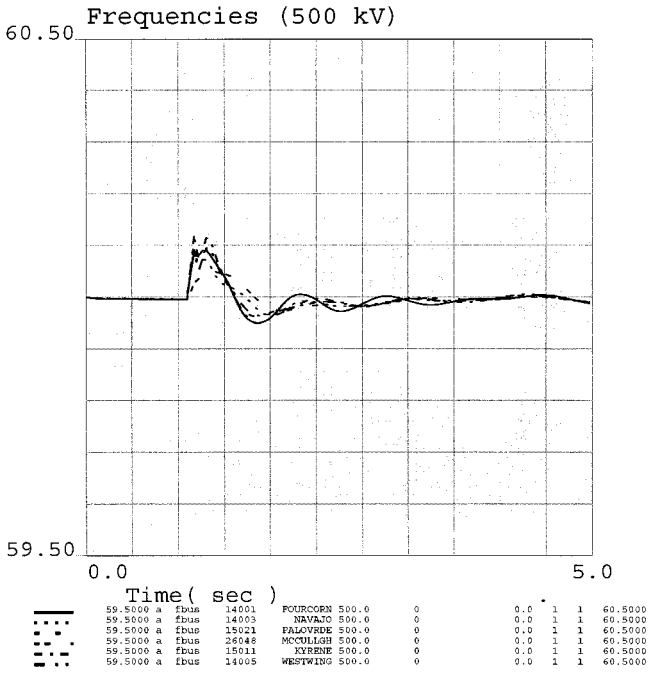

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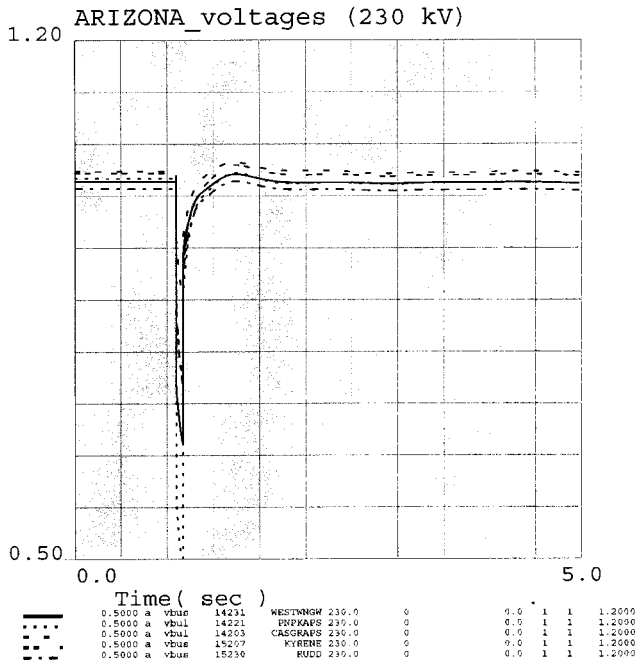

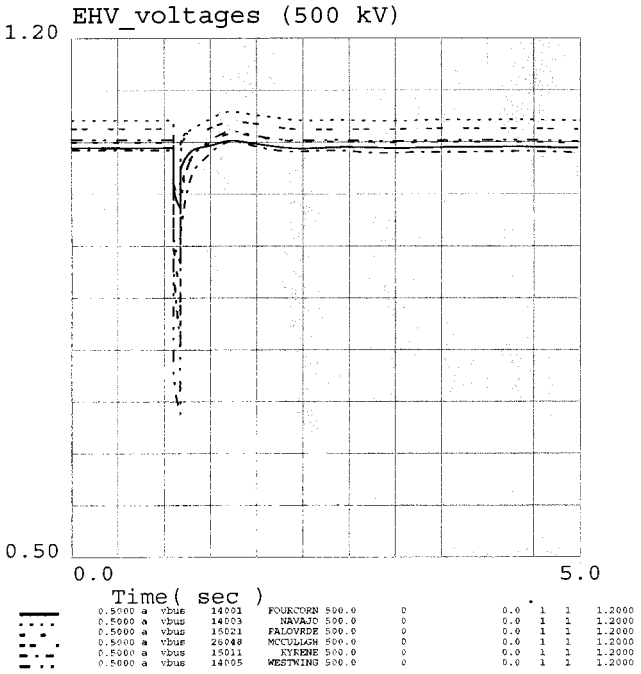

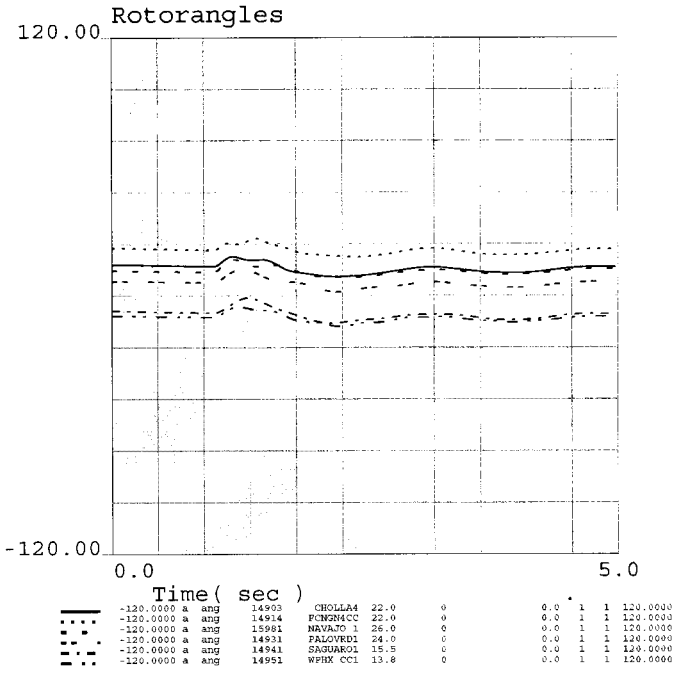

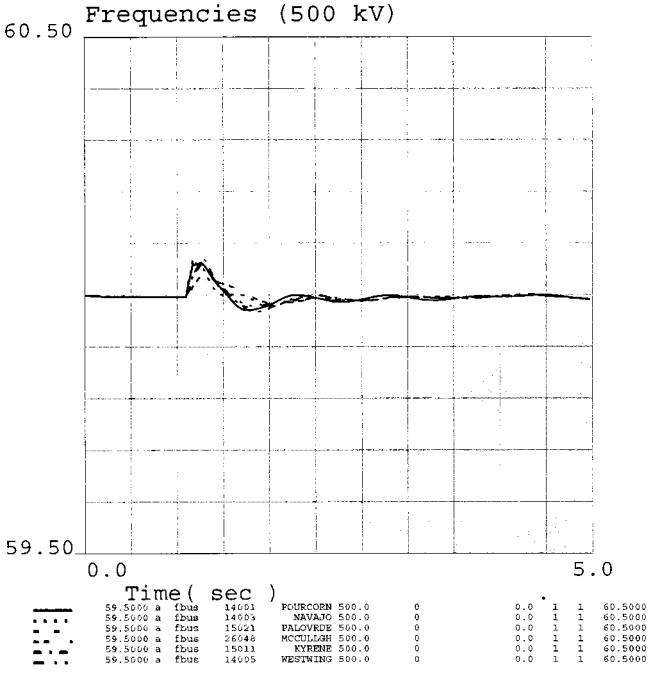

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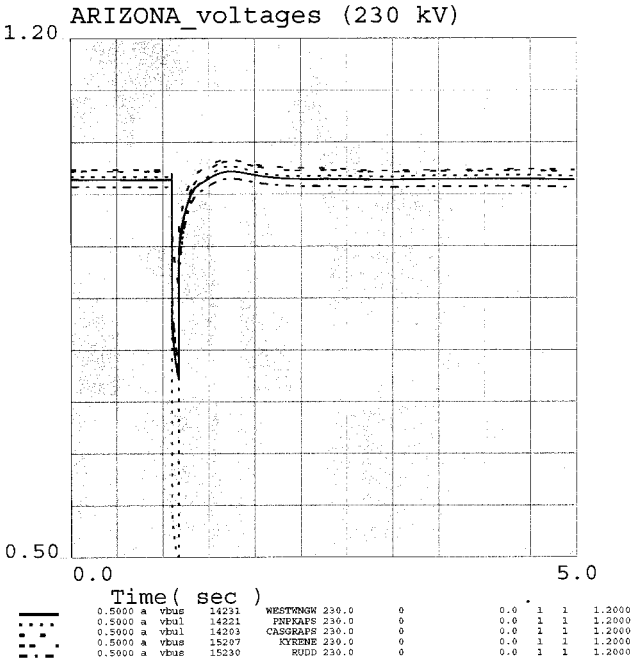

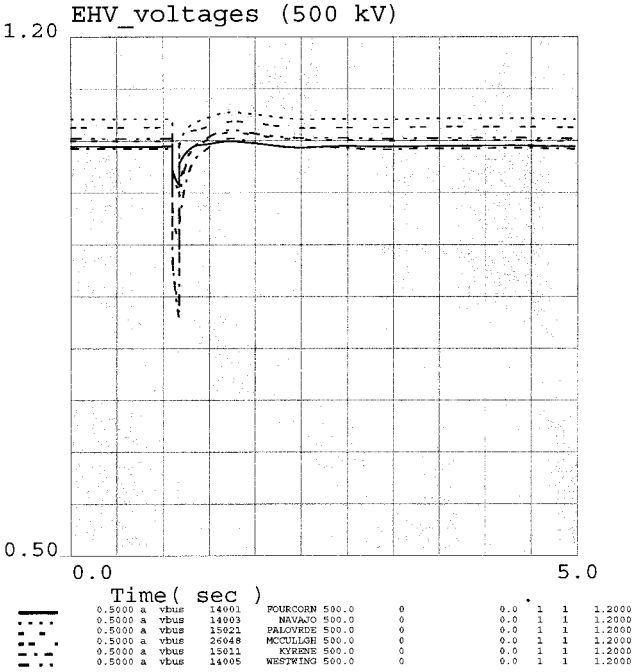

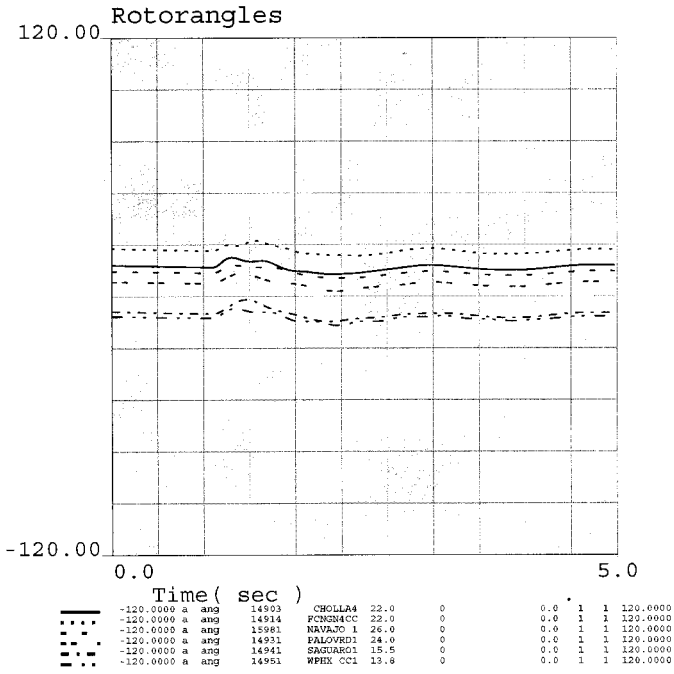

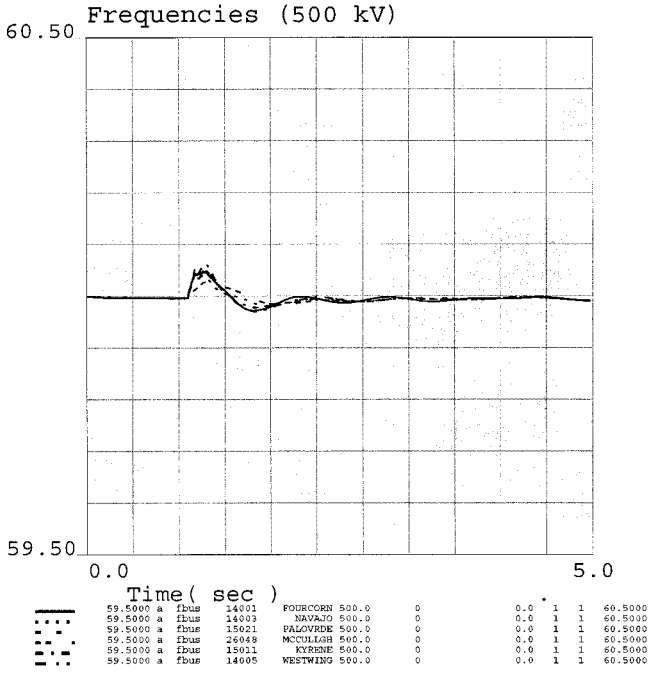

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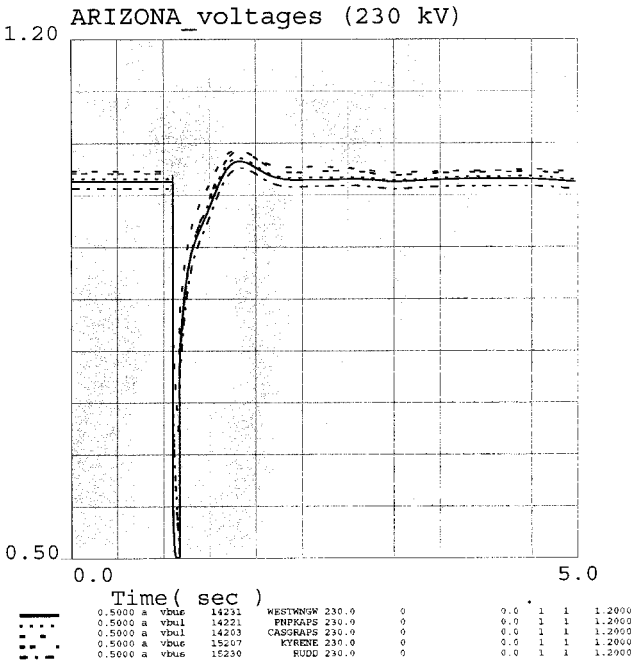

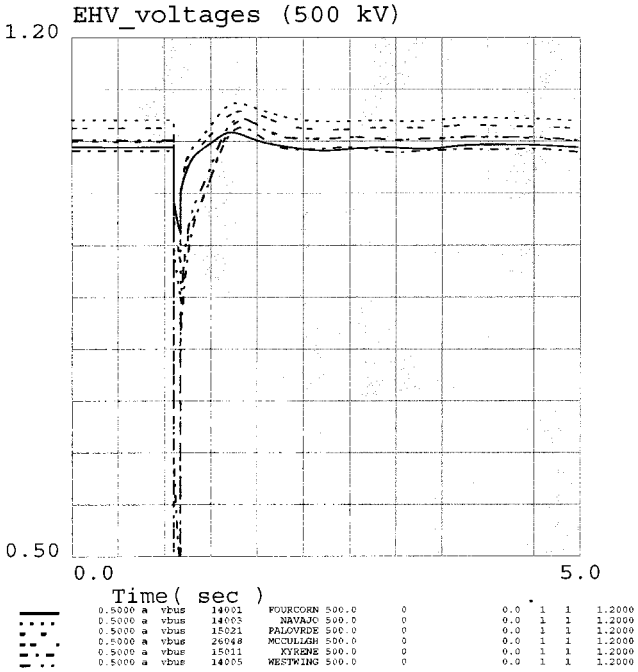

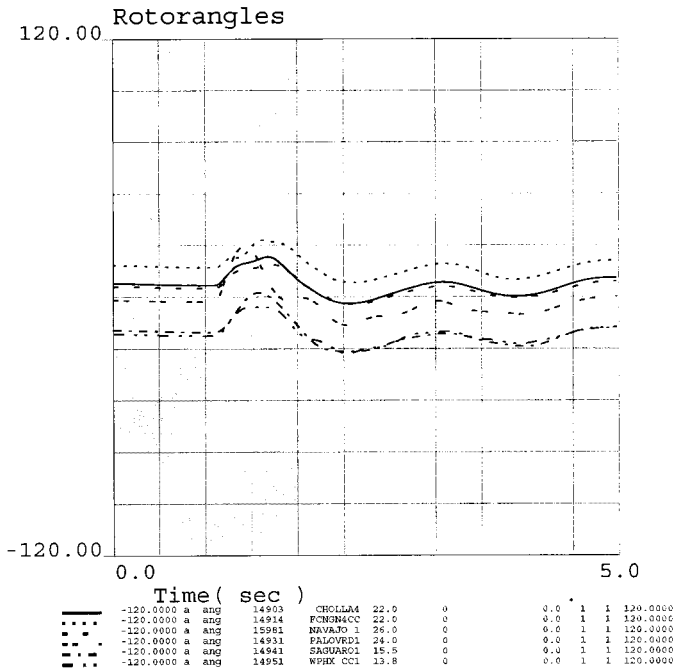

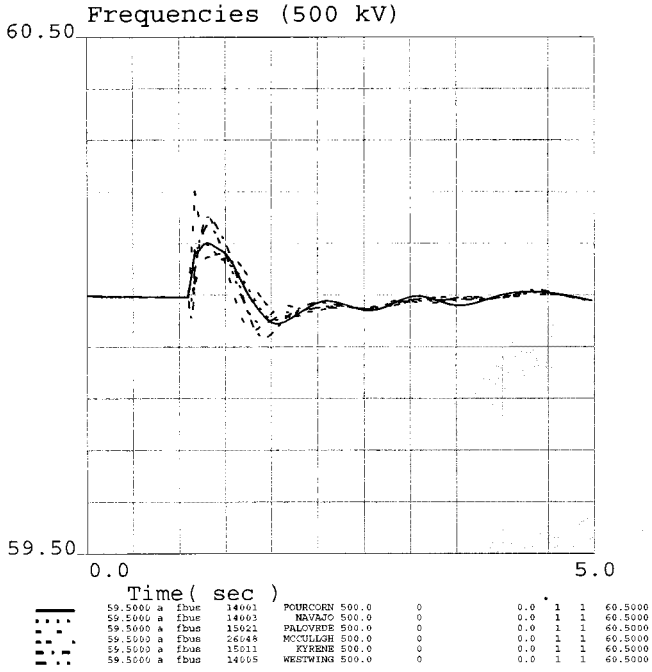

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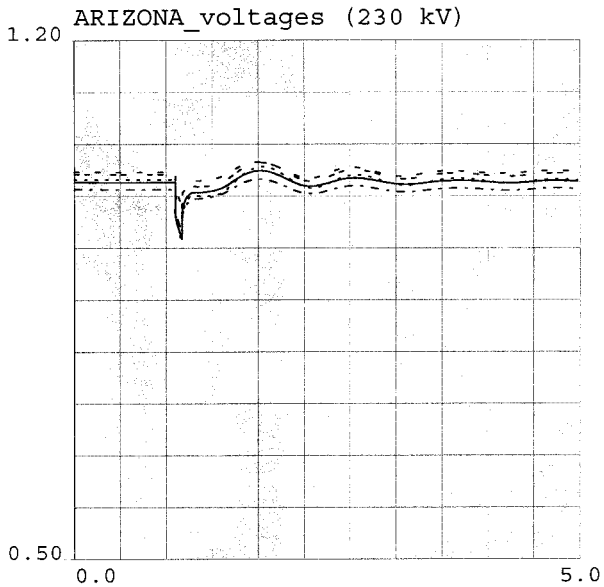

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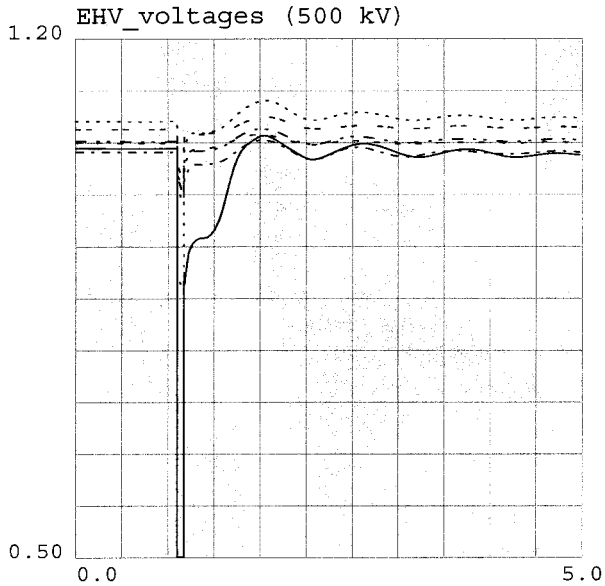
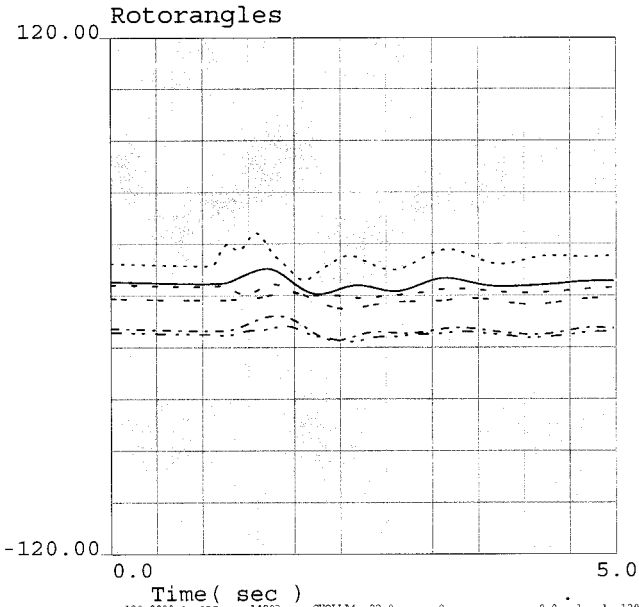
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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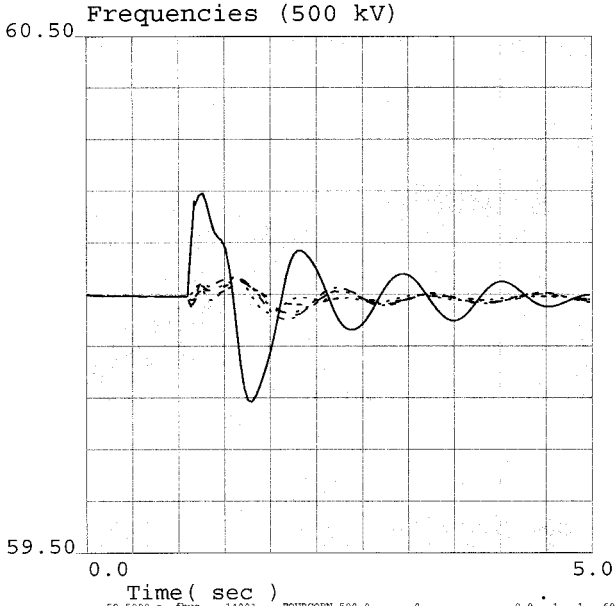

59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
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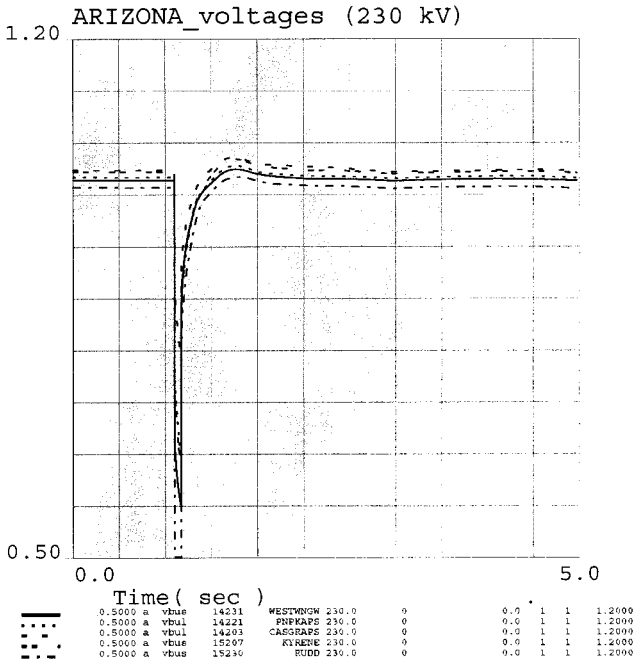

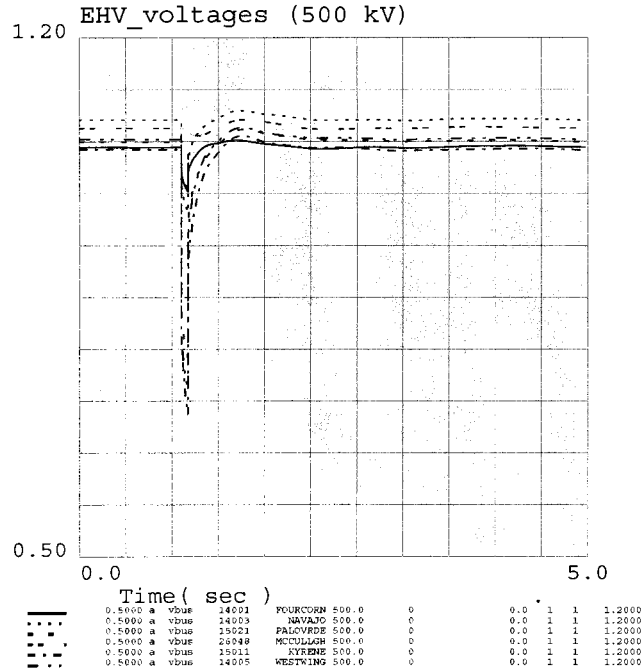

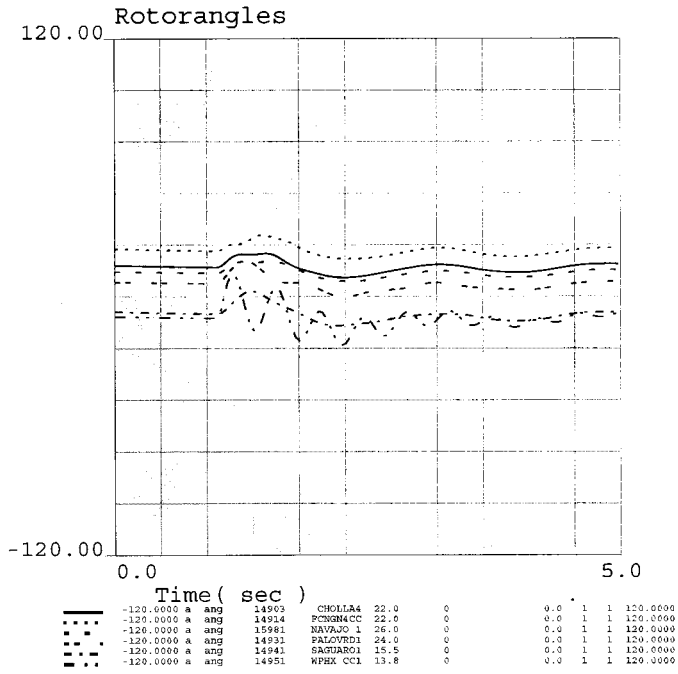

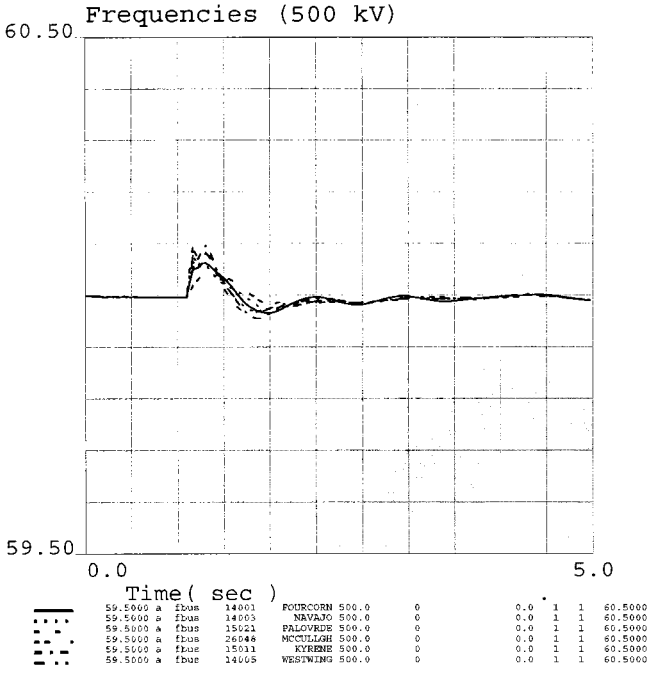

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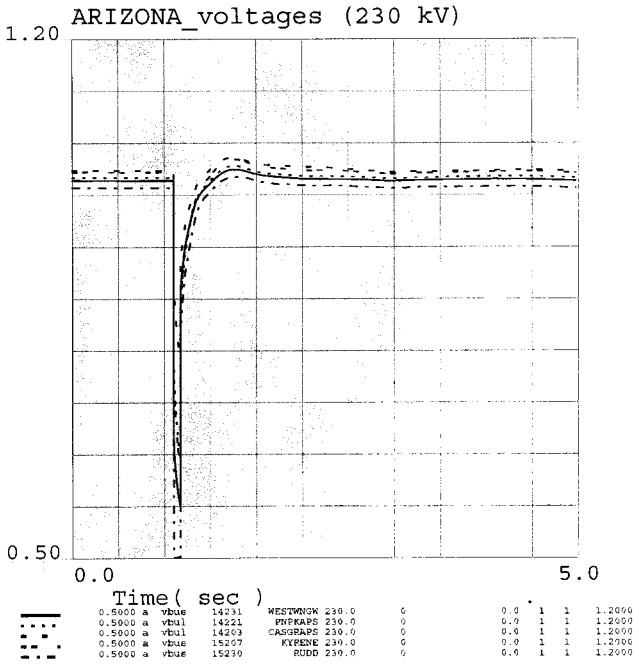

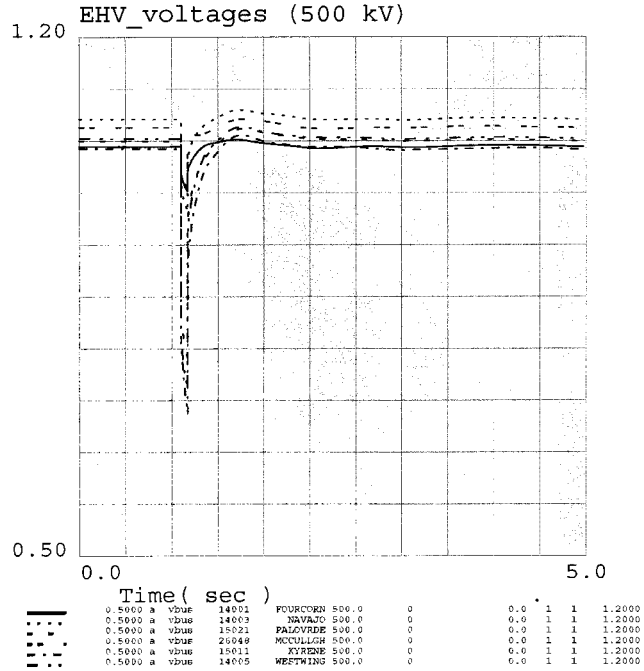

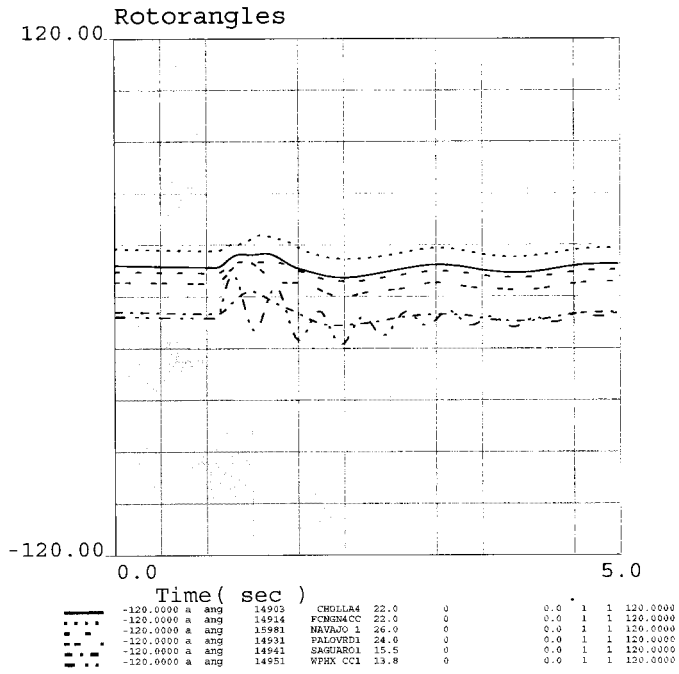

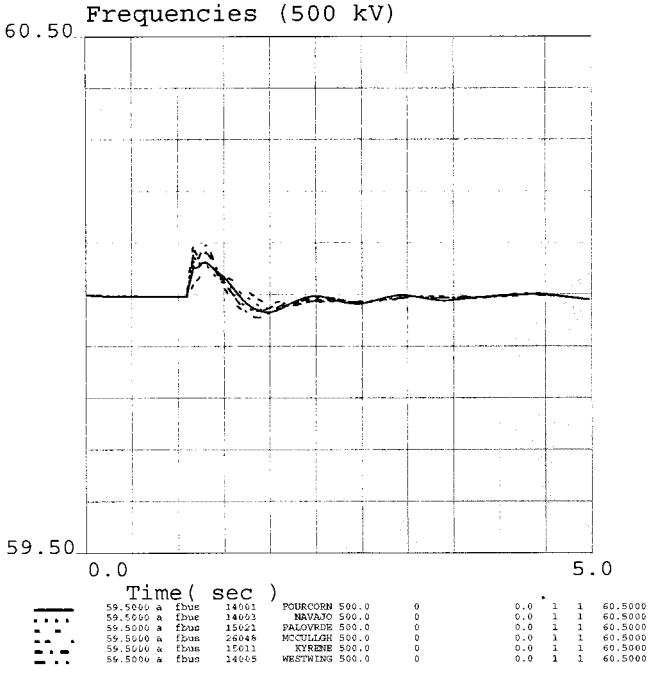

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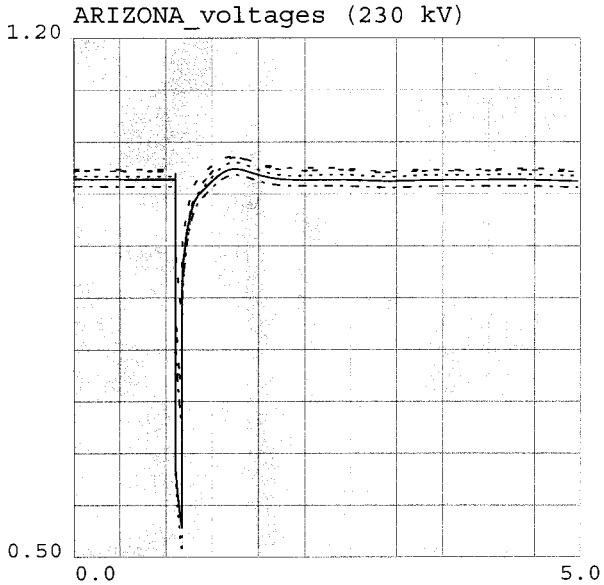
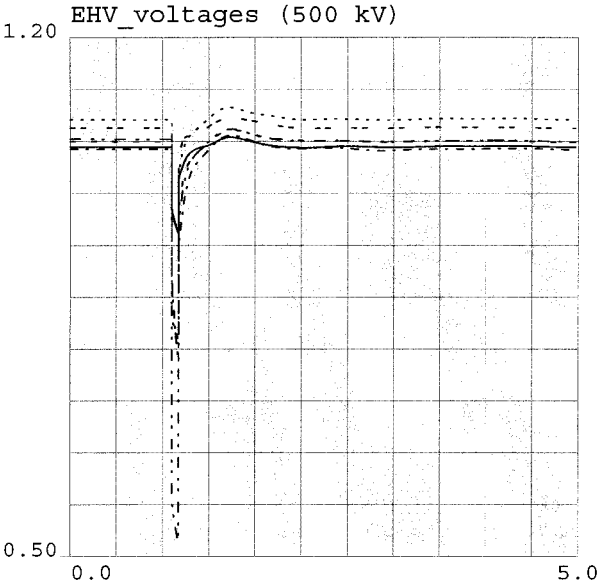
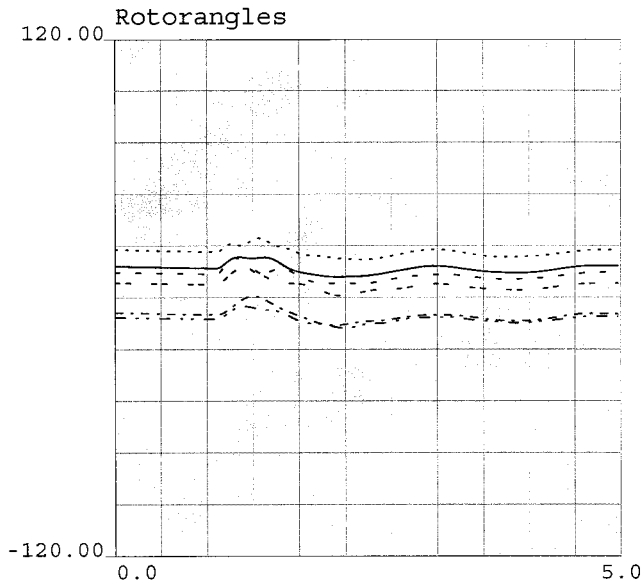


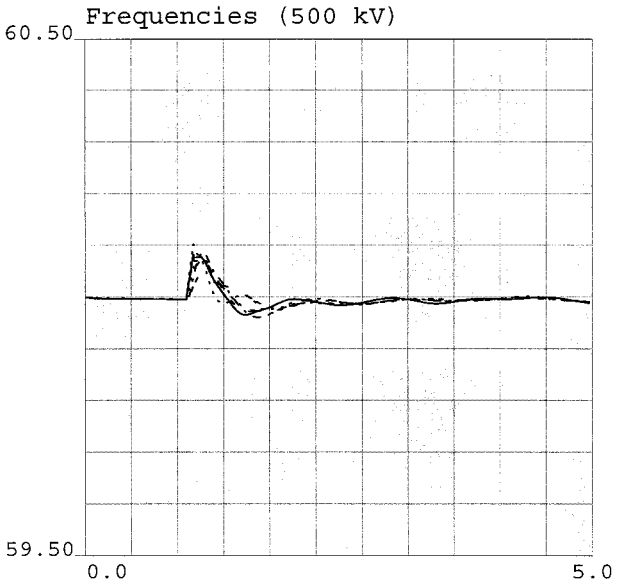
0.5000 a	vbus	14231	WESTKNGW	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000 a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000 a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	15981	NAVAJO_1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000 a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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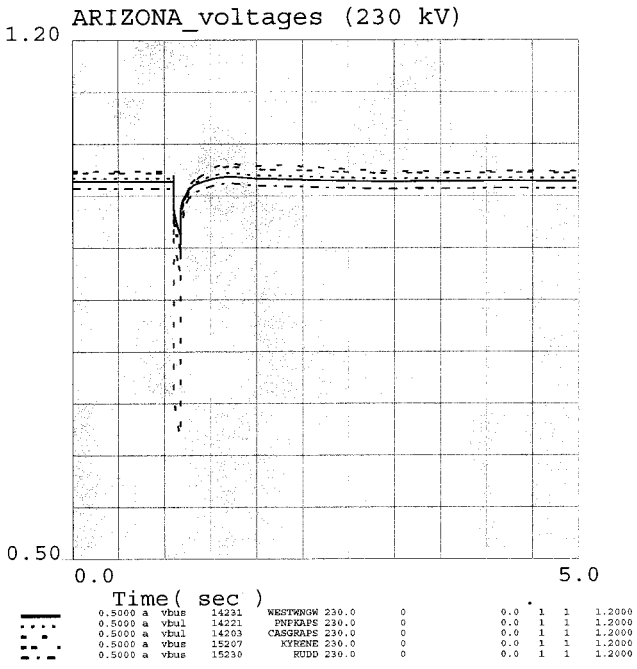

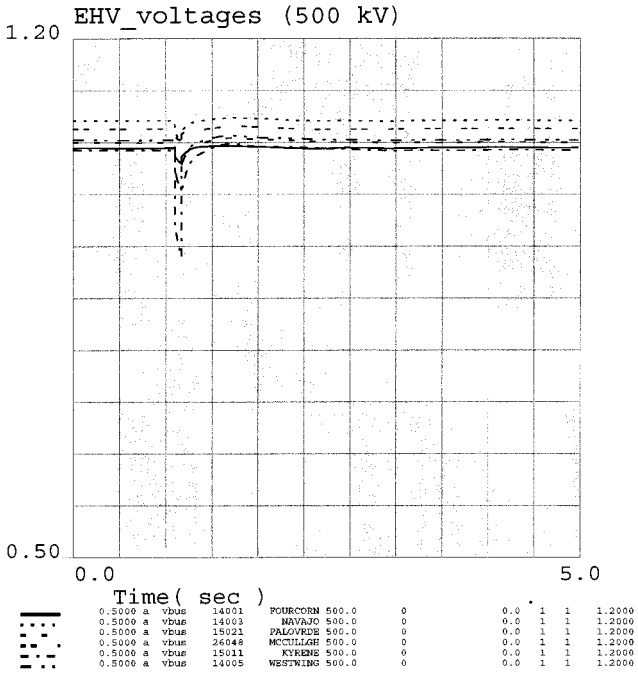

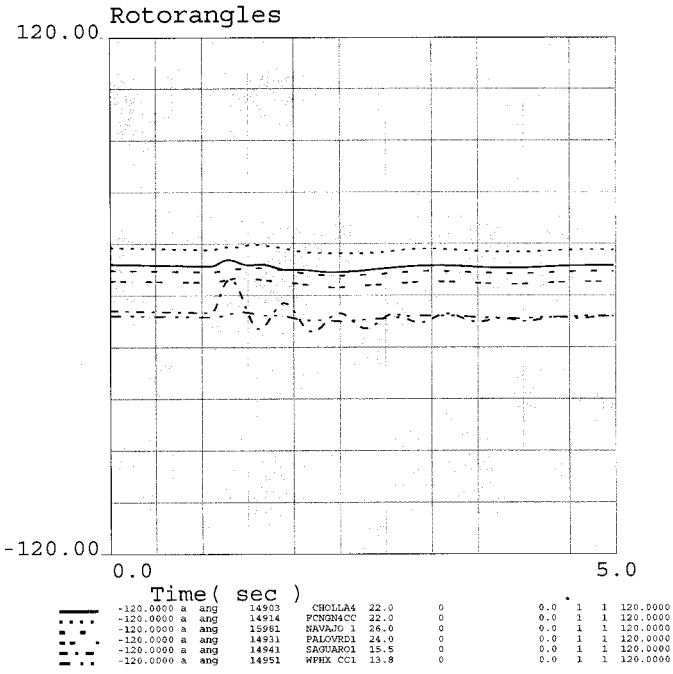

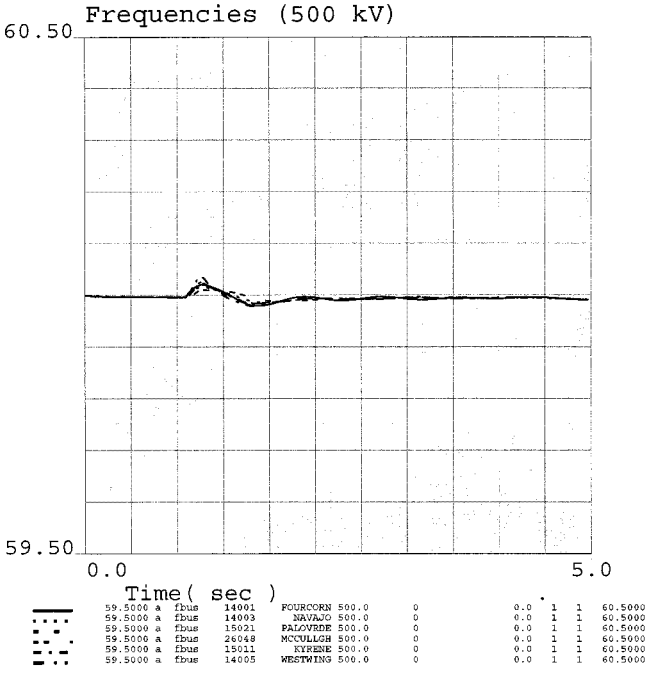

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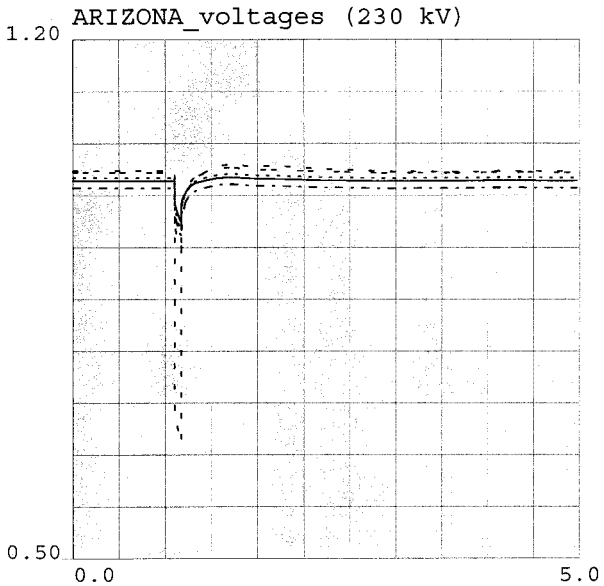

0.5000 a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
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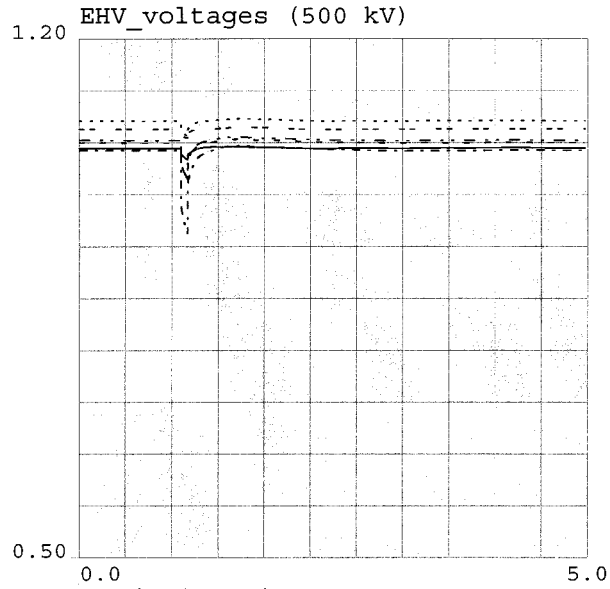

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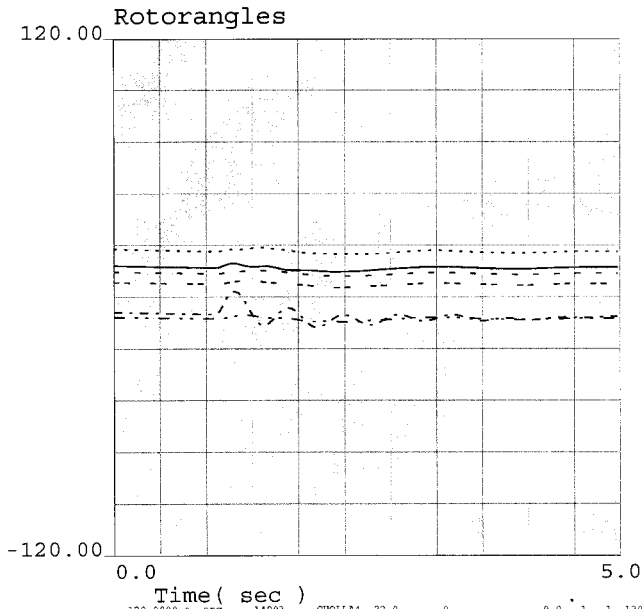
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



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-120.0000 a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	15981	NAVAJO_1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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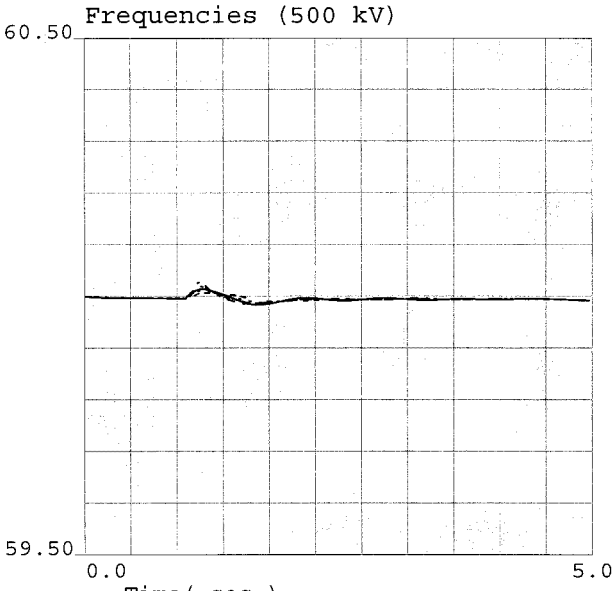

59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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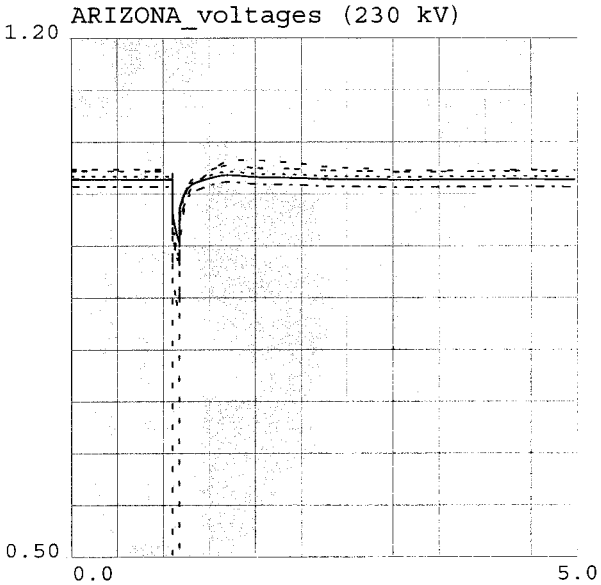

0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
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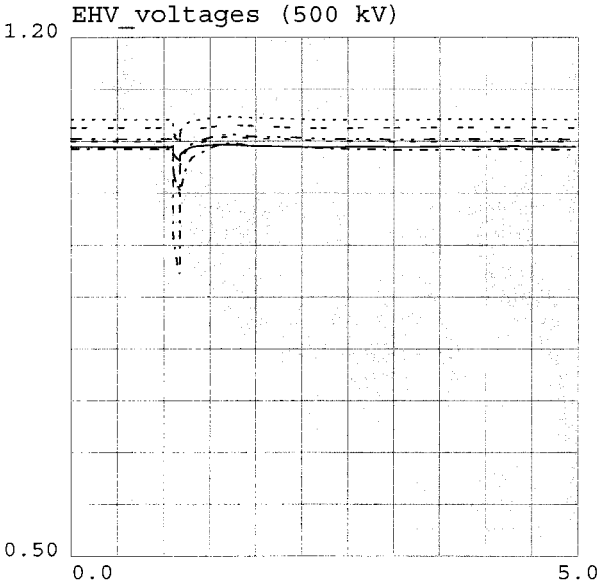

0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
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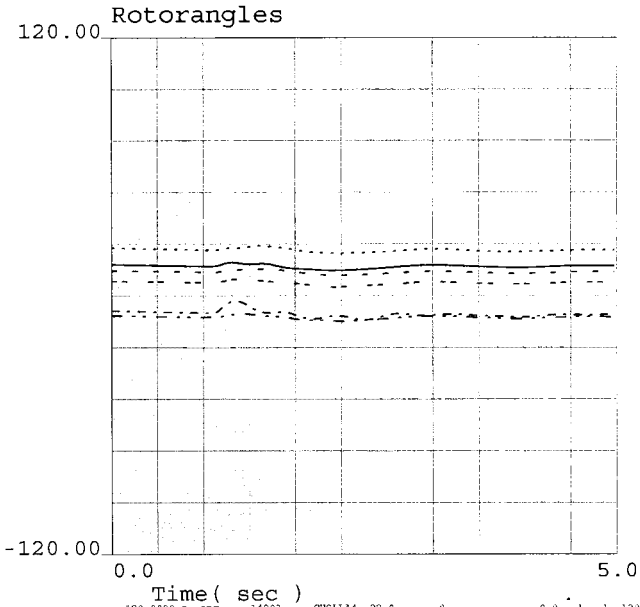

-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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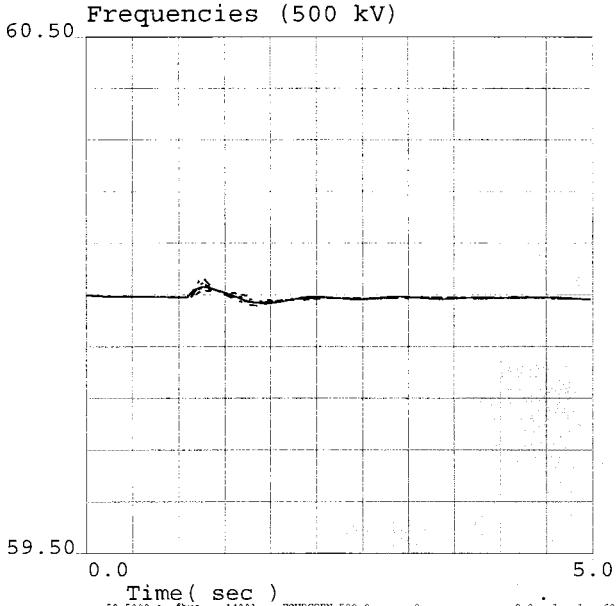

59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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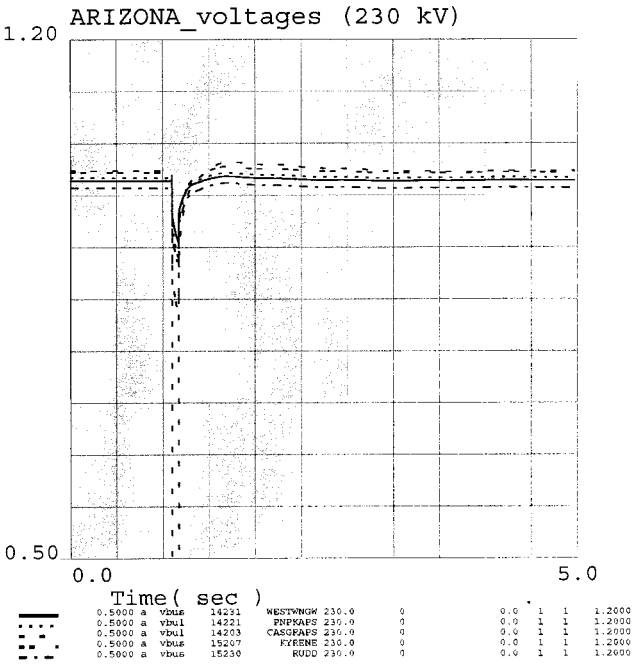

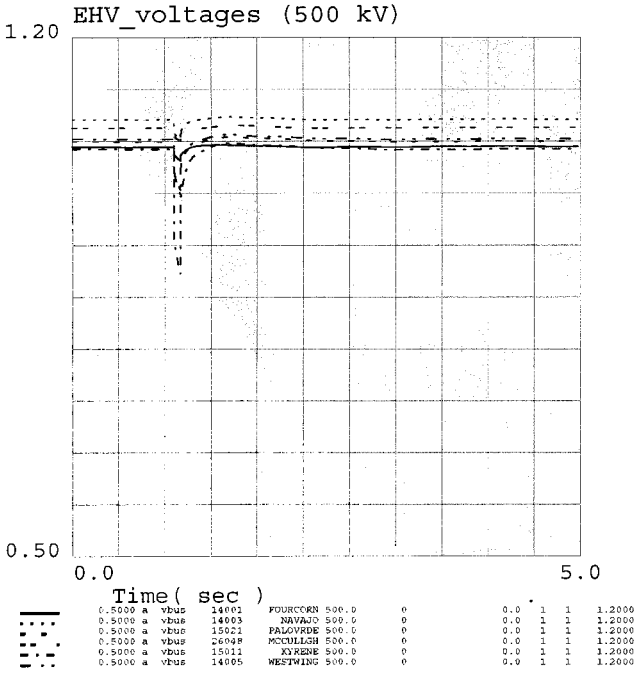

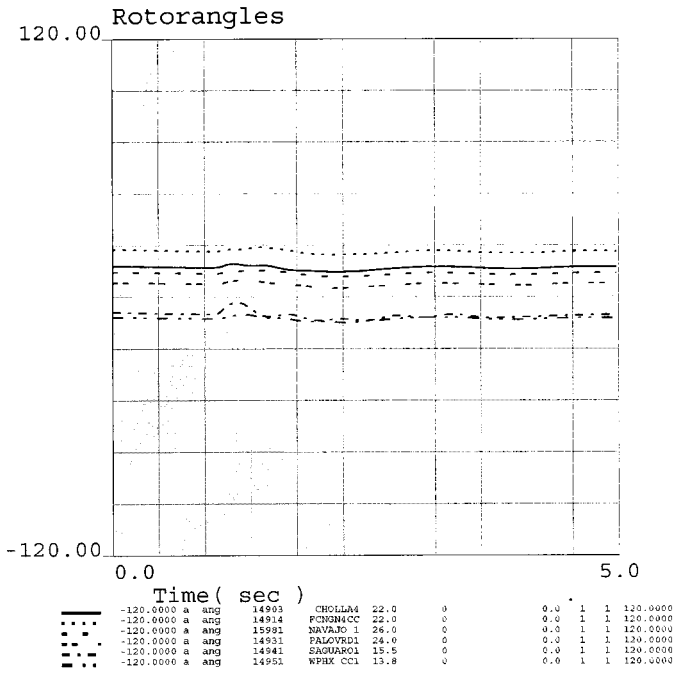

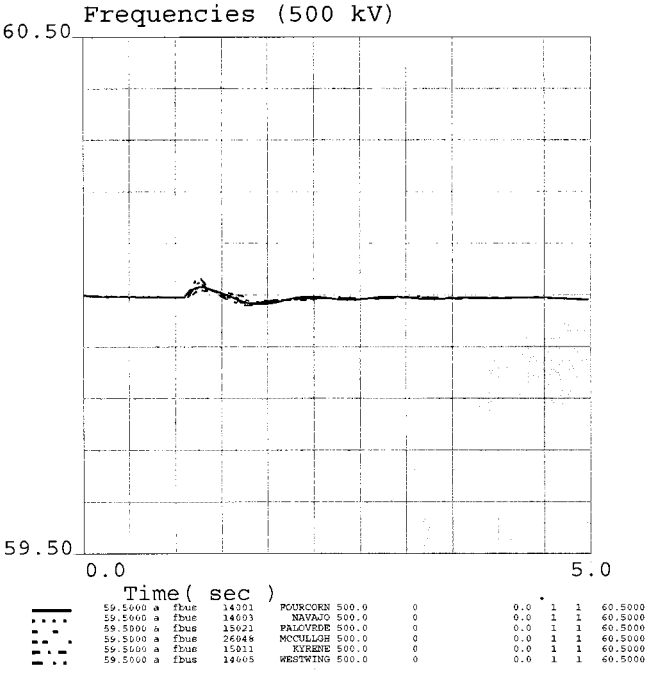

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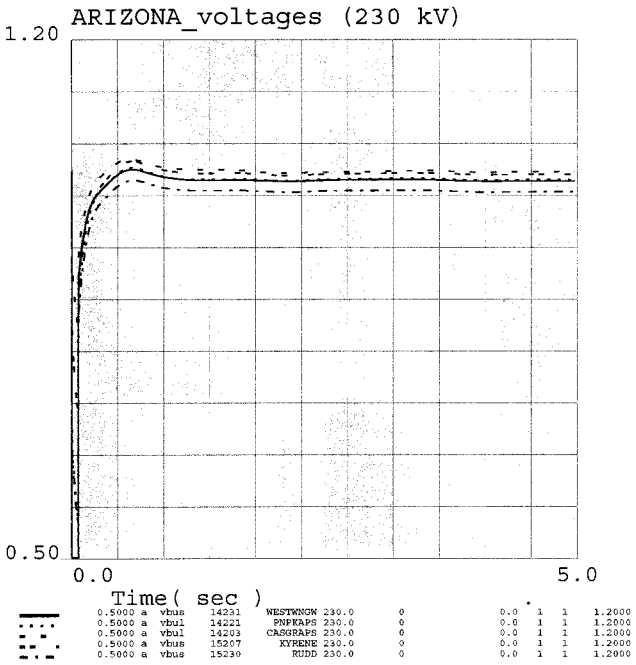

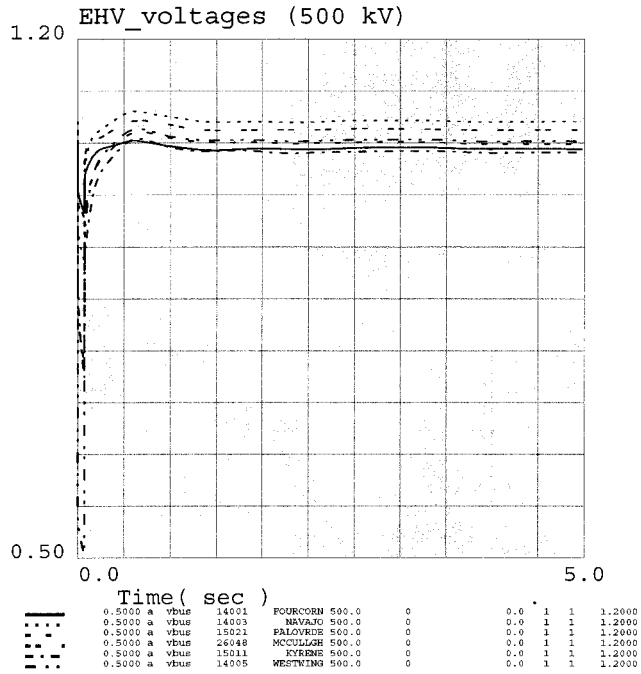

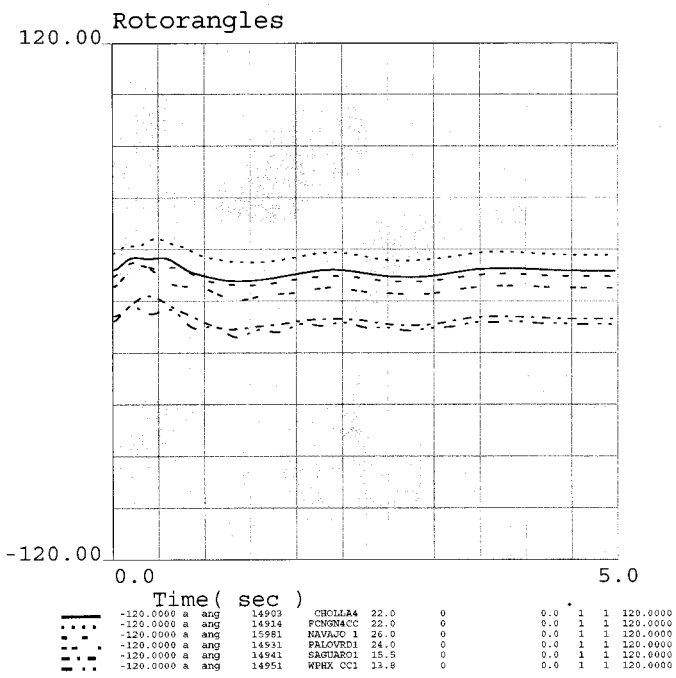

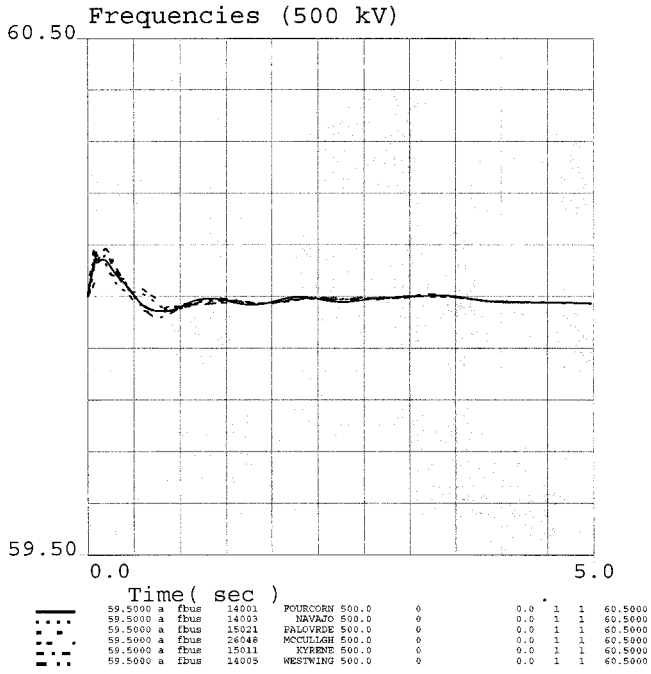

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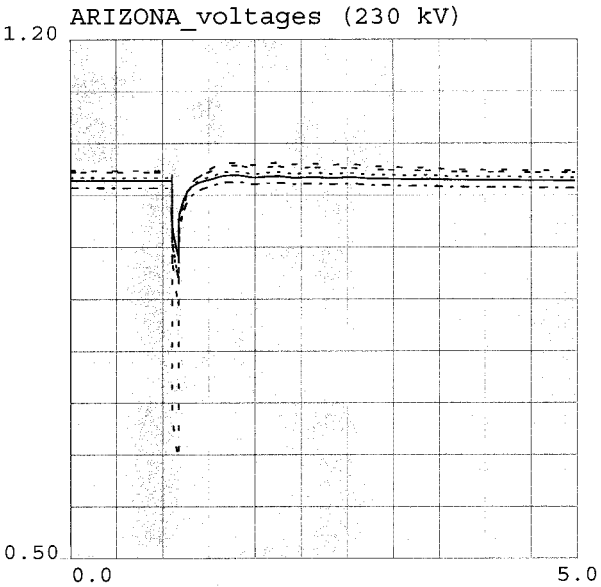
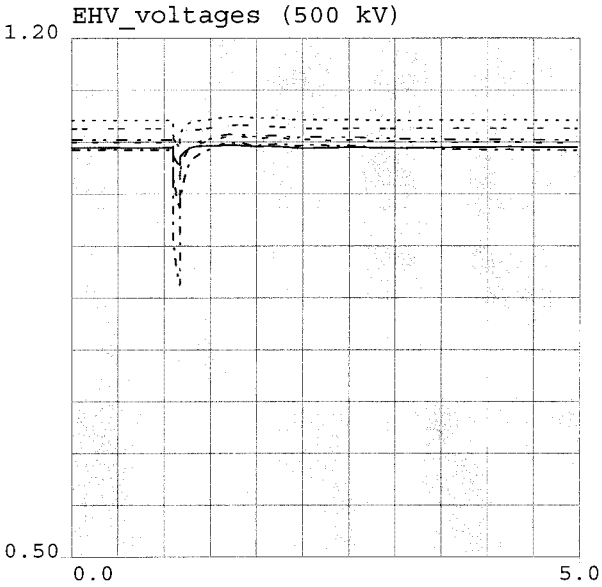
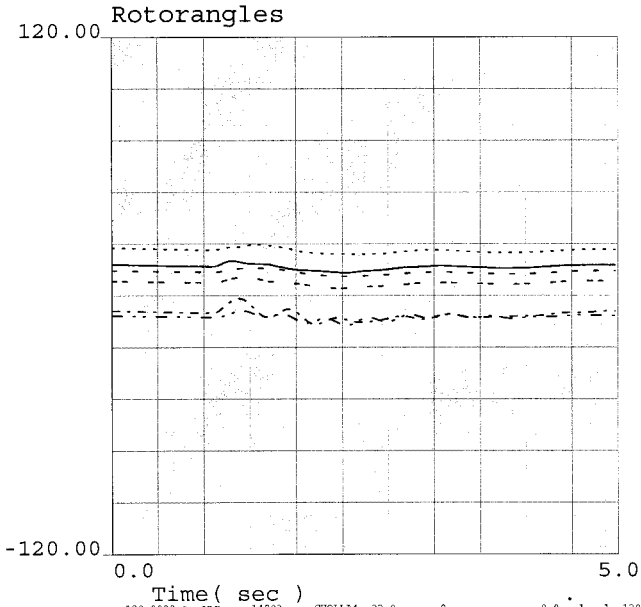


0.5000 a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000 a	vbul	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbul	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000 a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000 a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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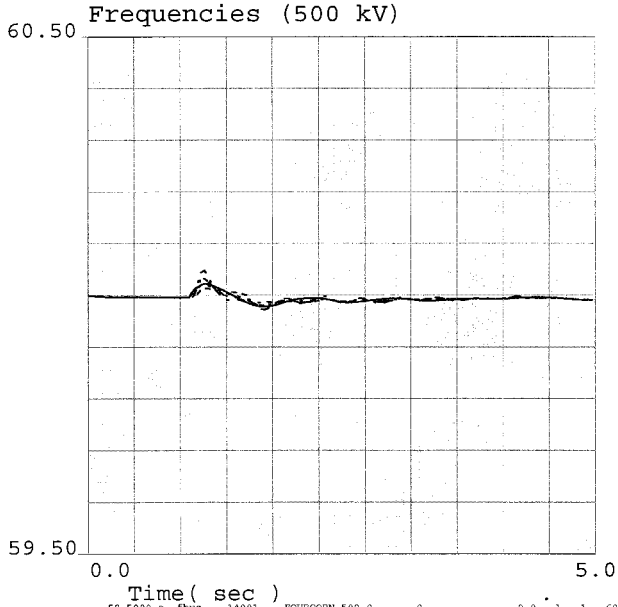

59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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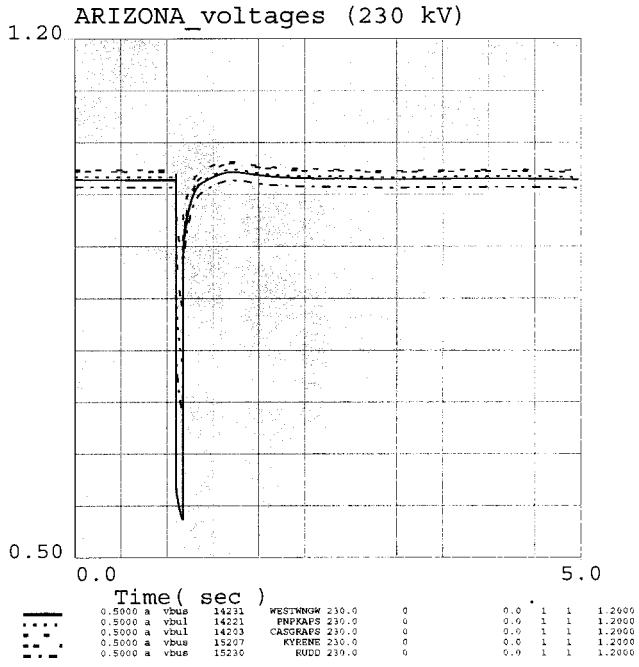

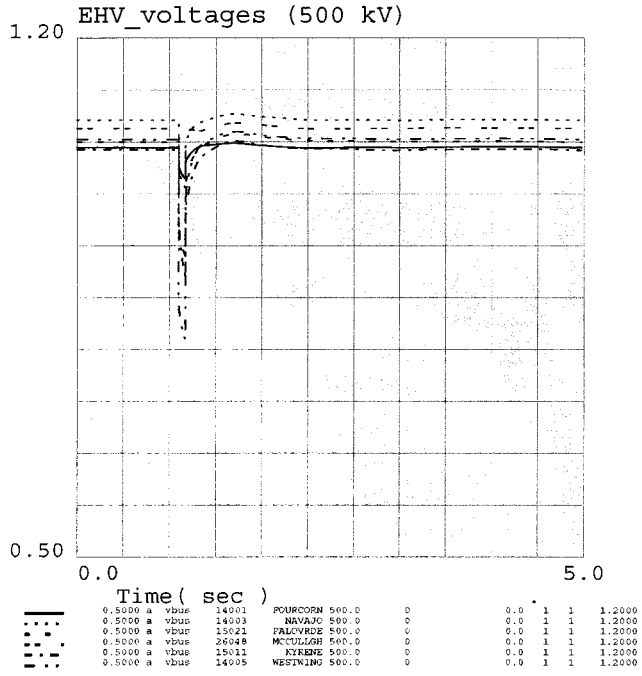

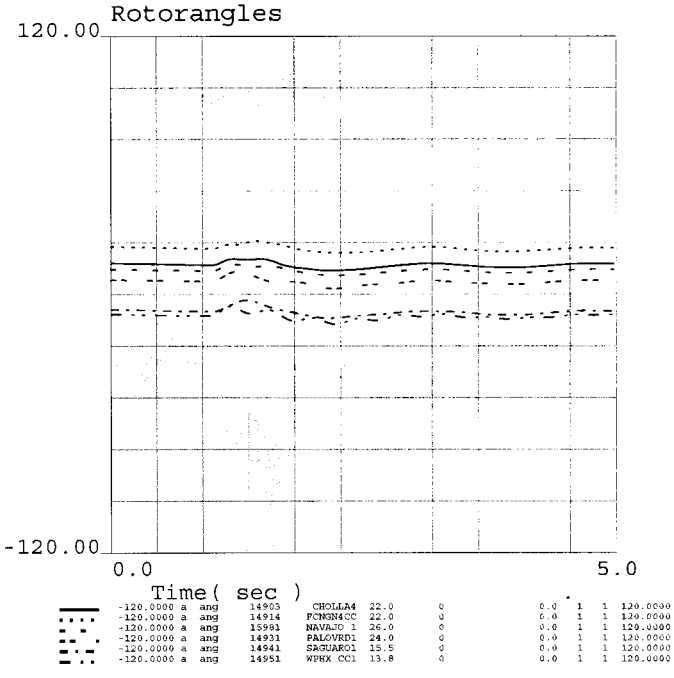

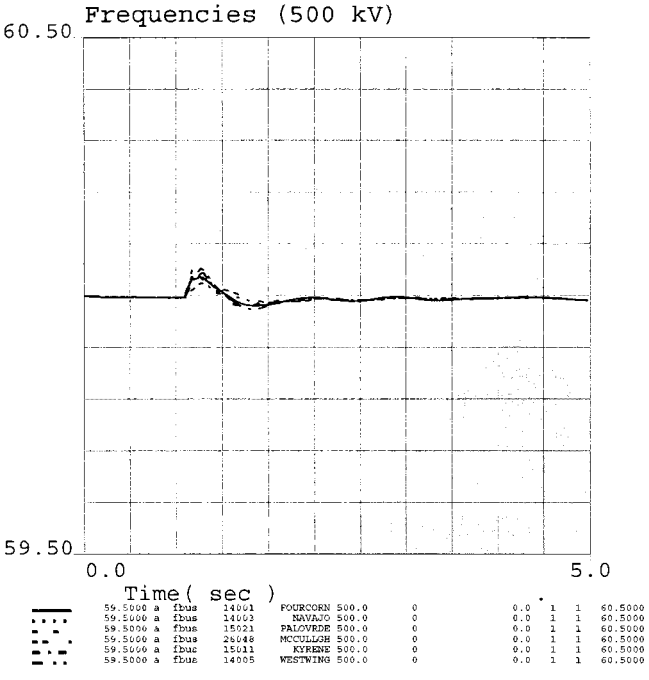

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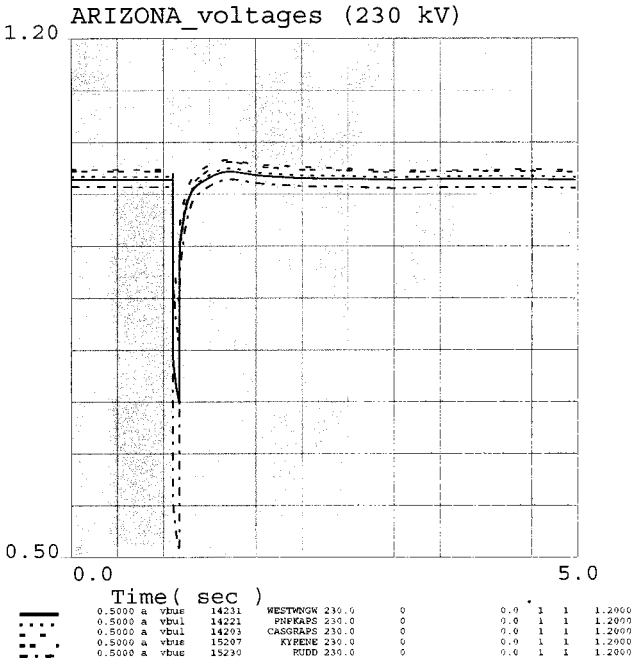

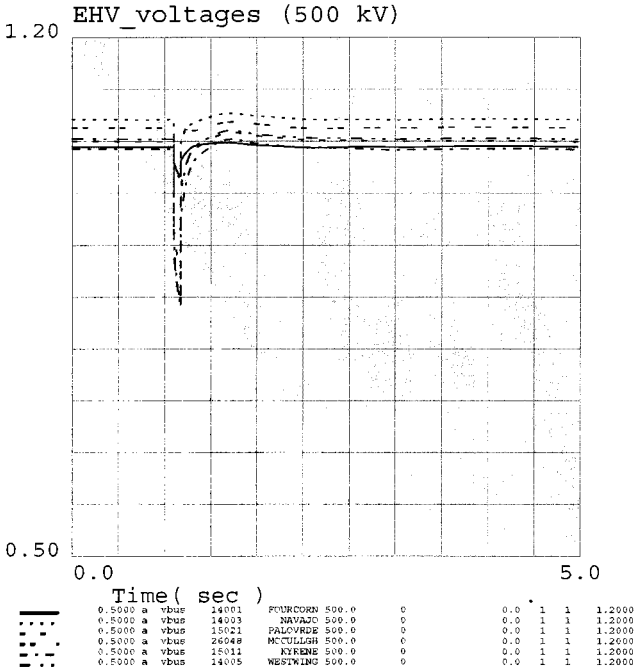

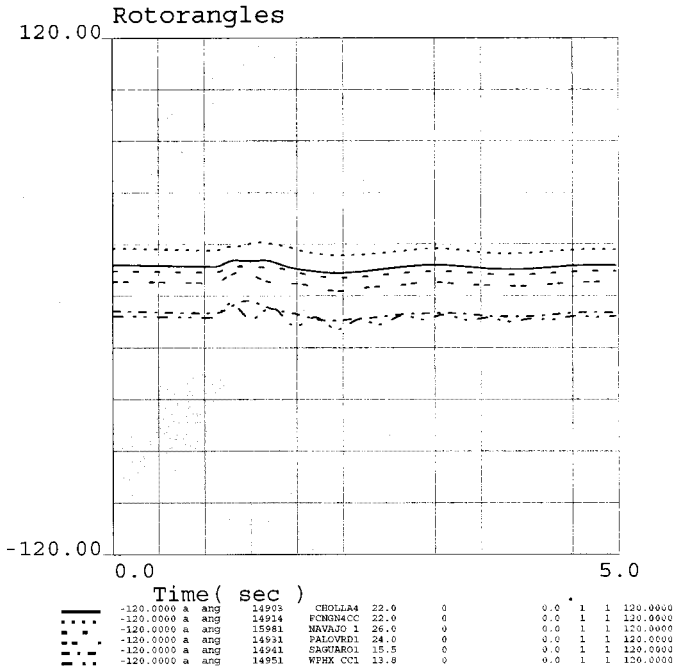

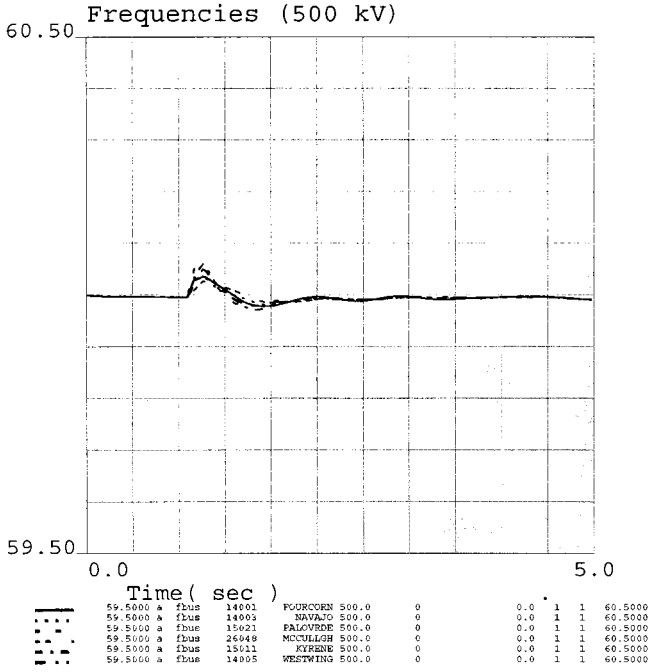

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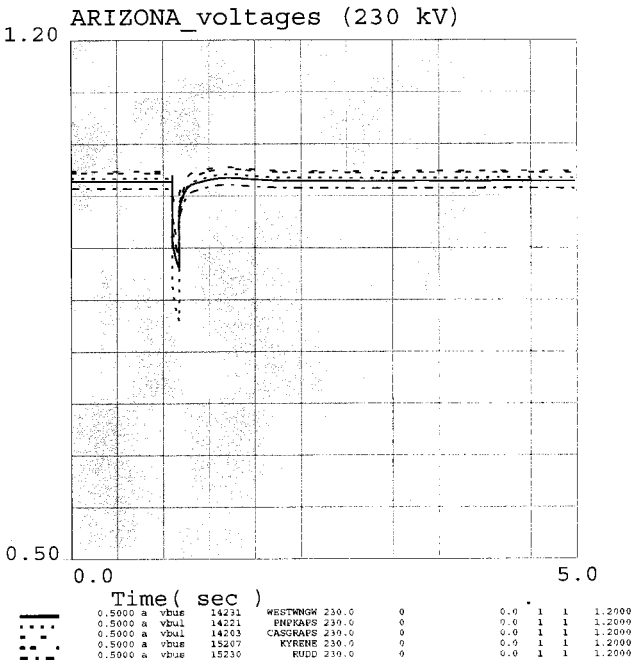

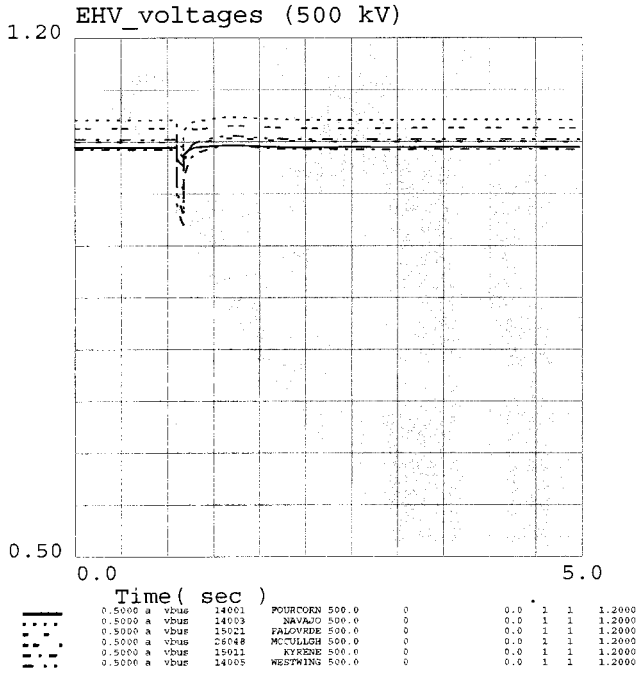

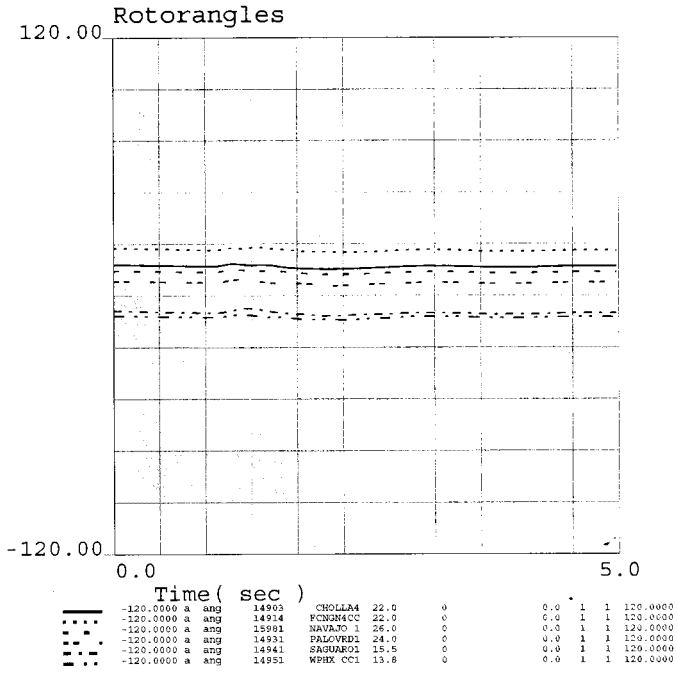

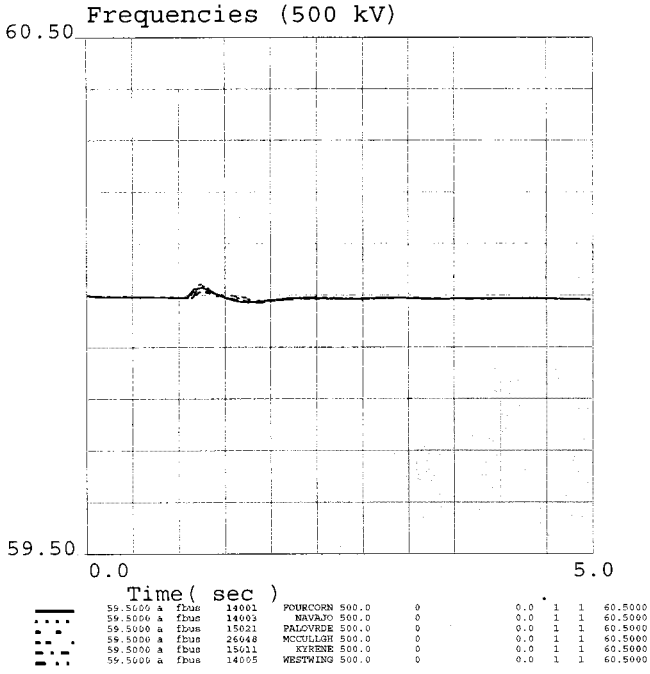

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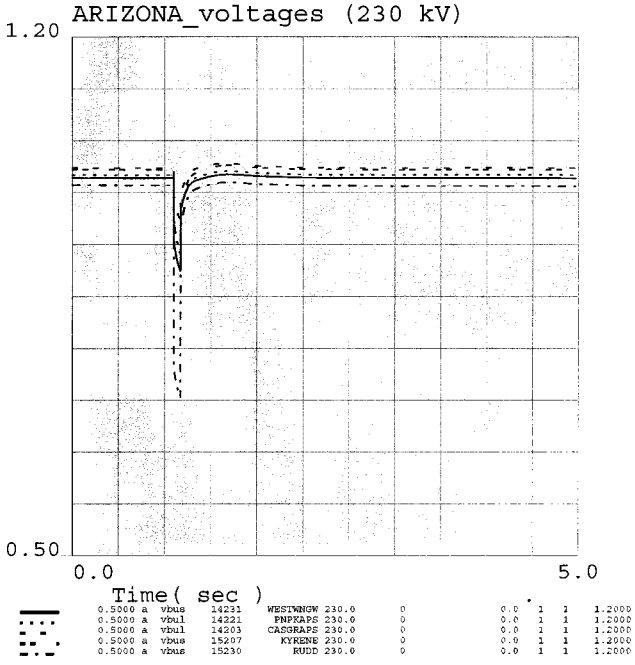

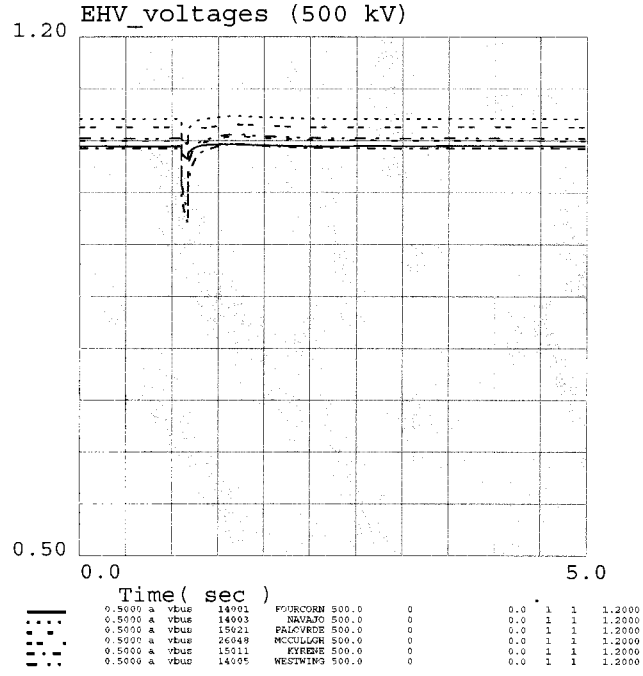

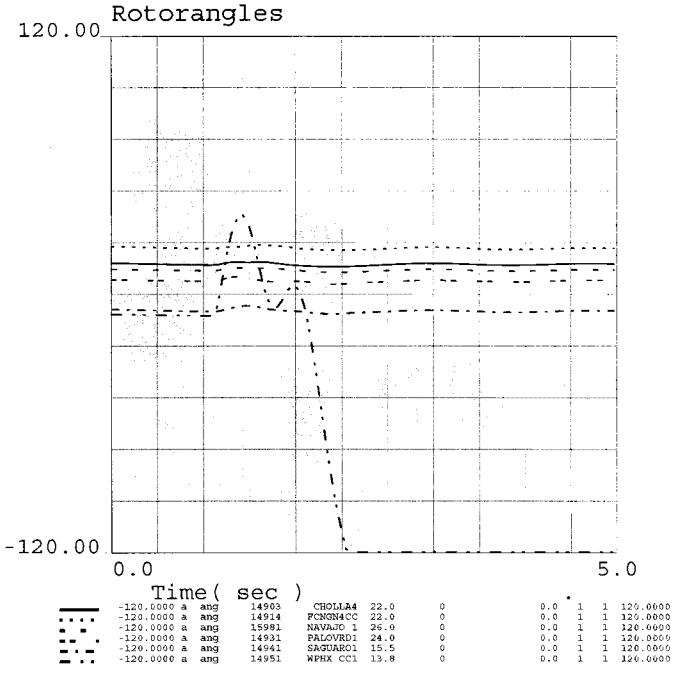

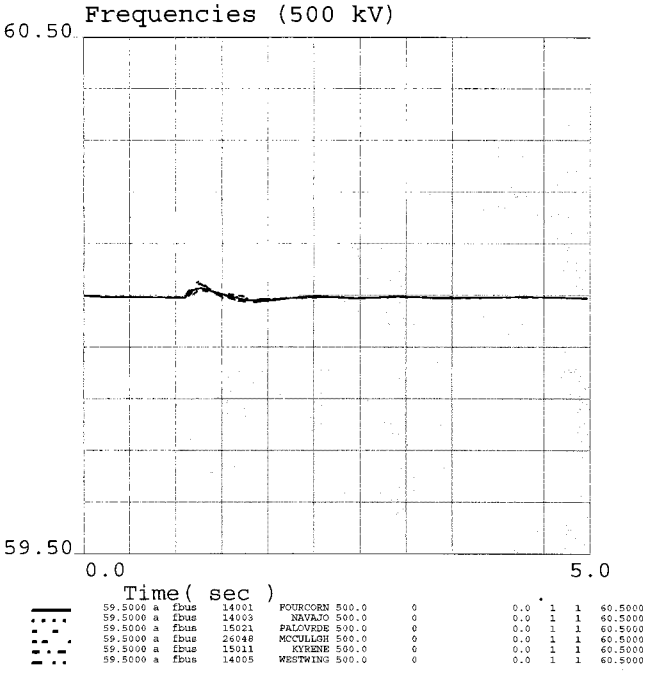

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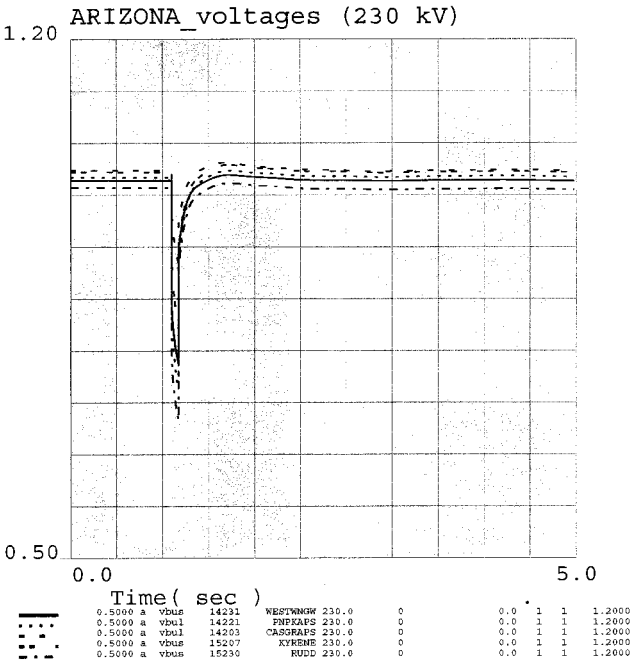

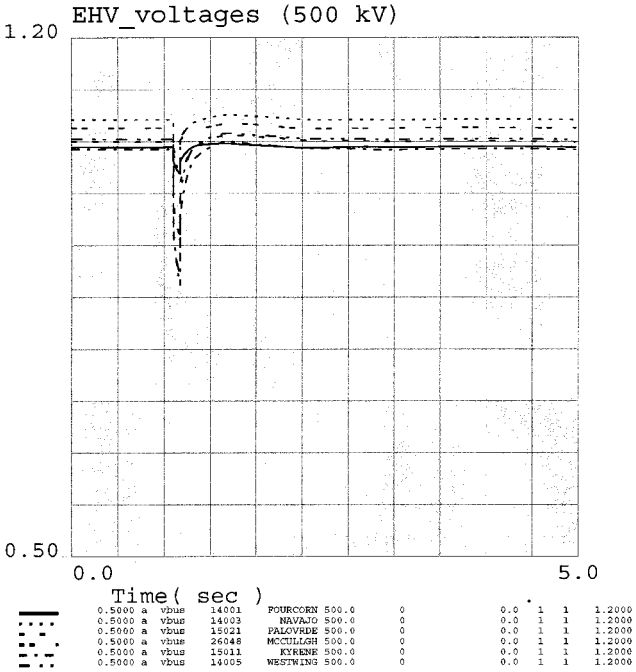

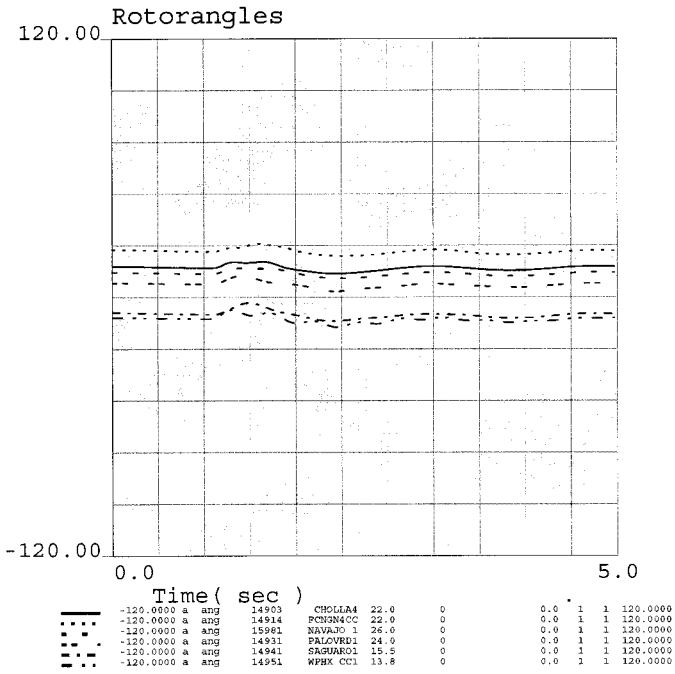

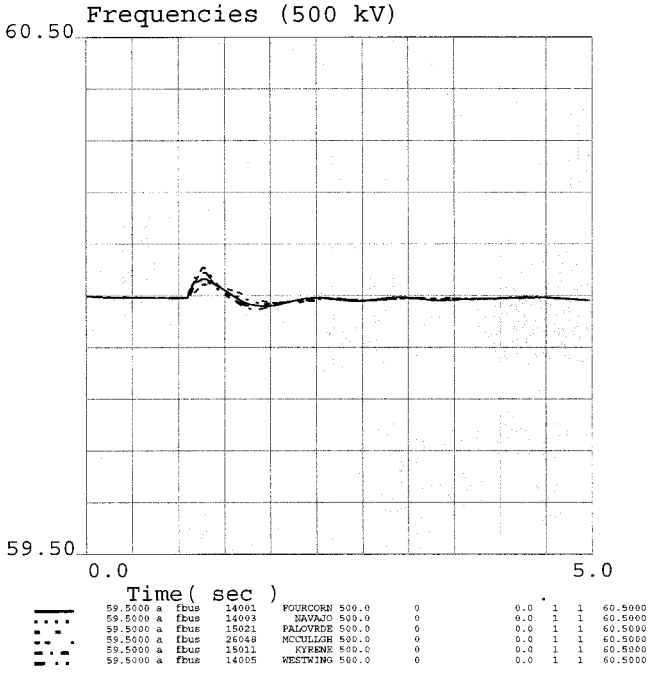

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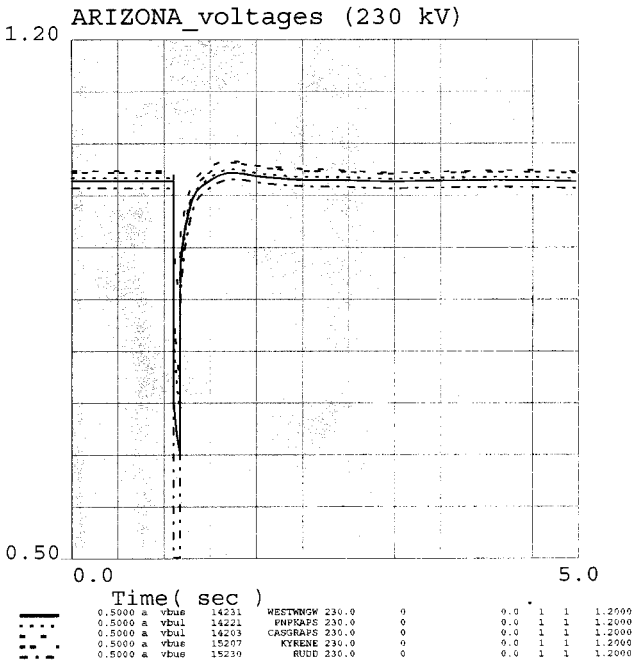

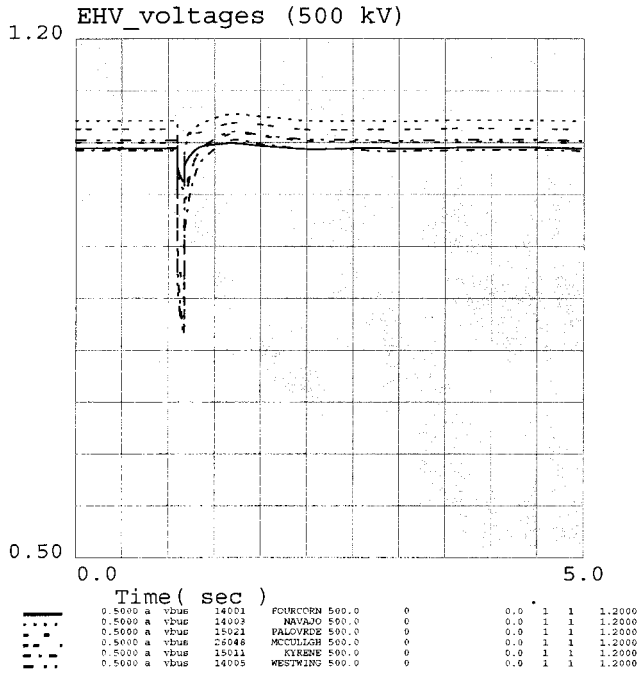

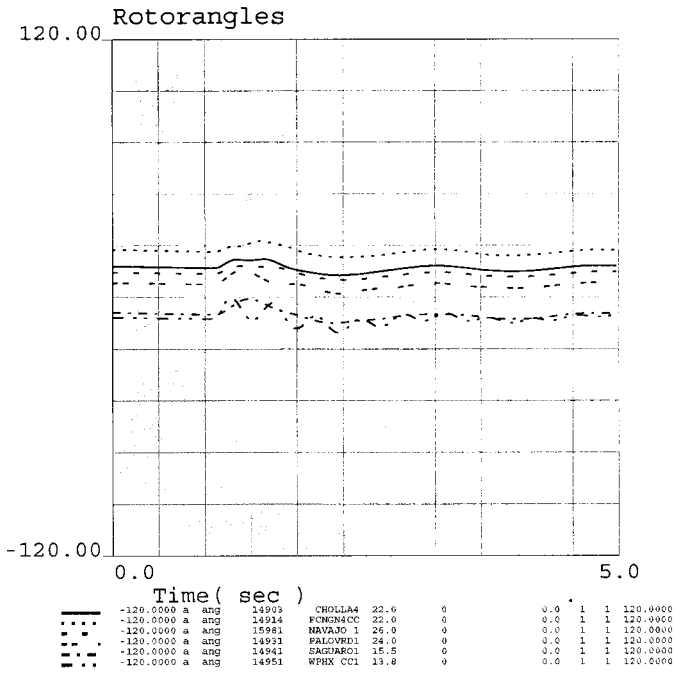

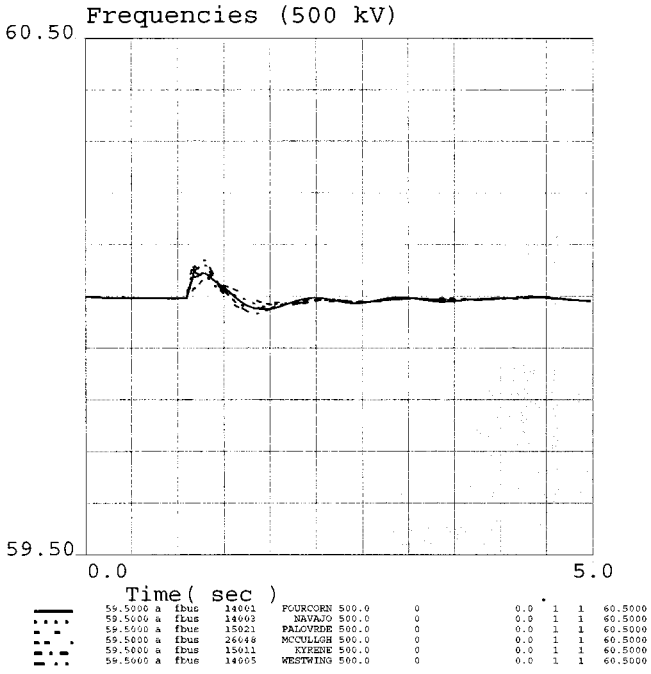

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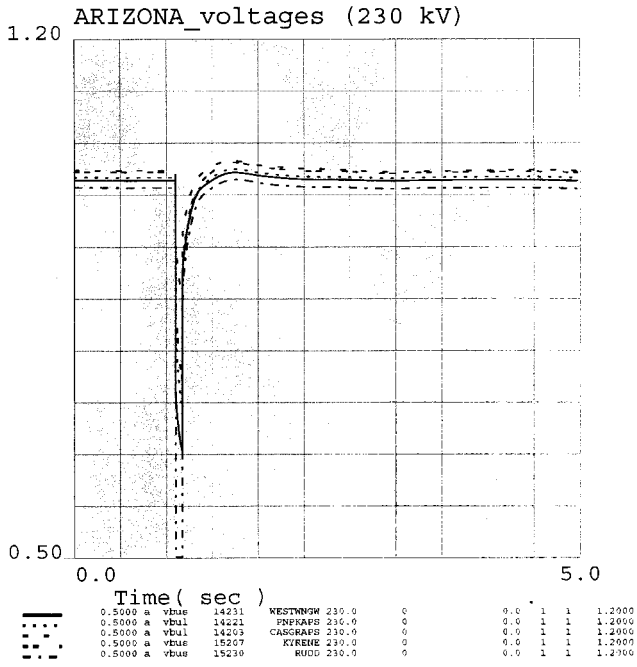

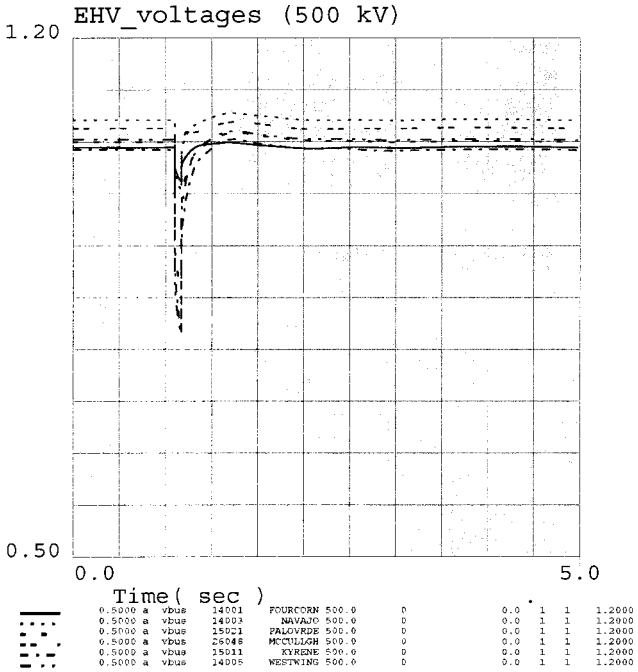

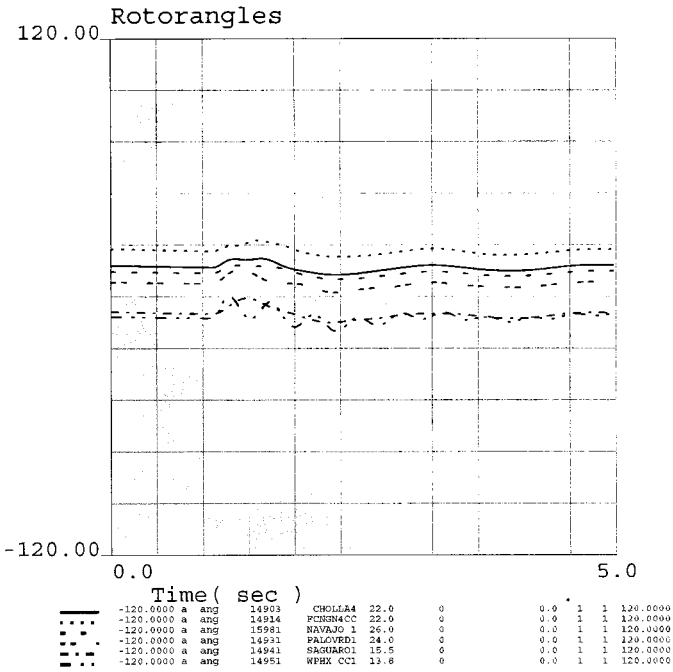

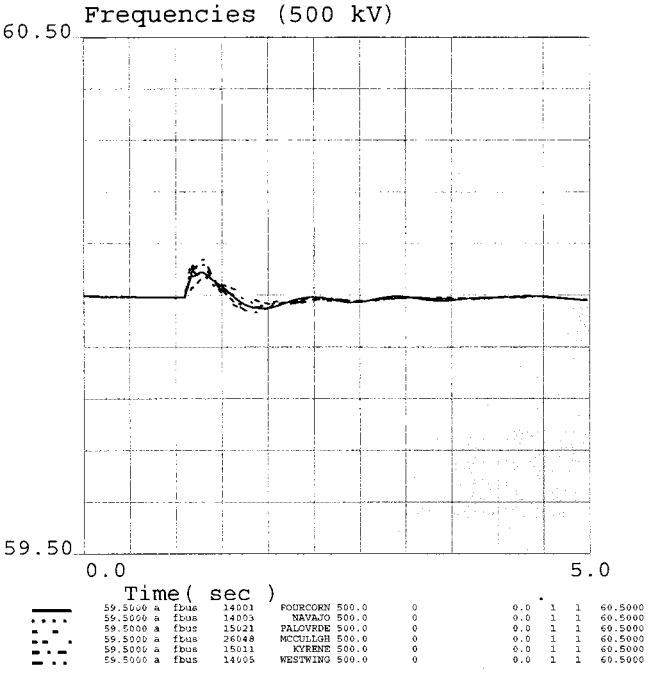

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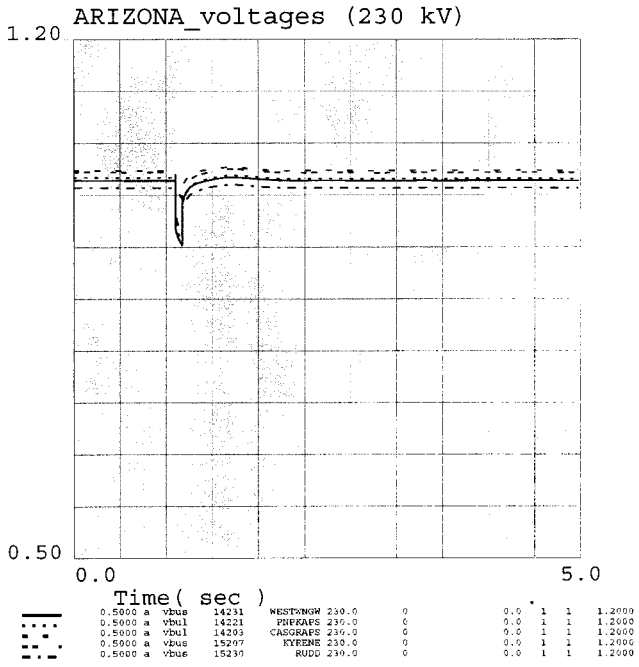

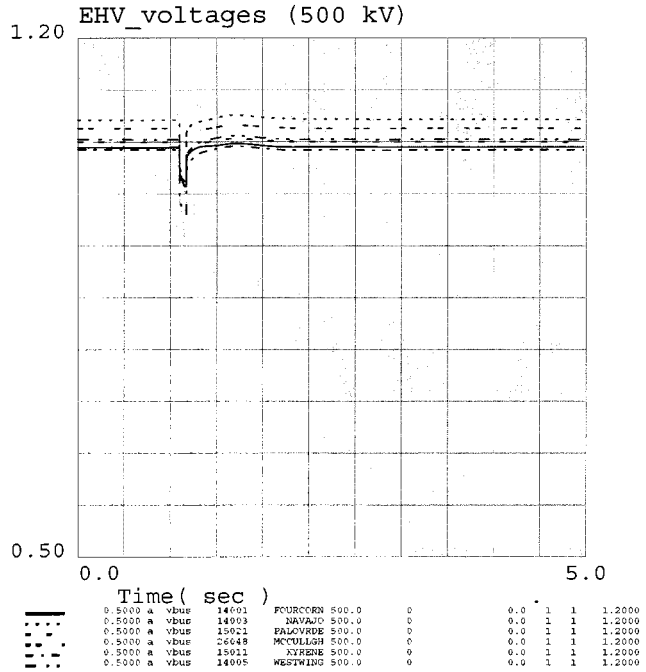

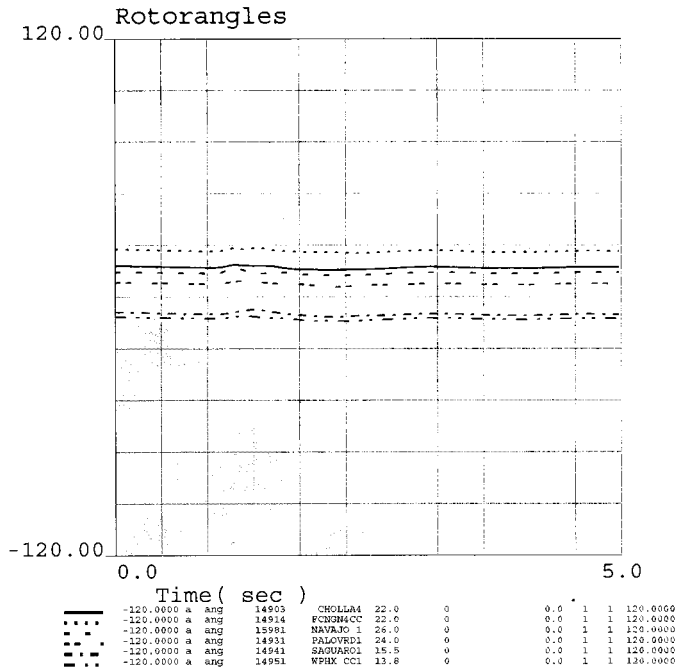

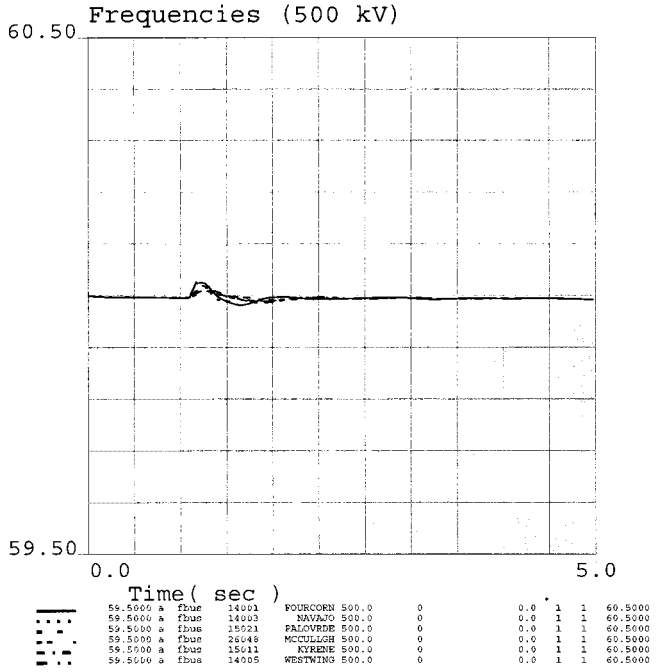

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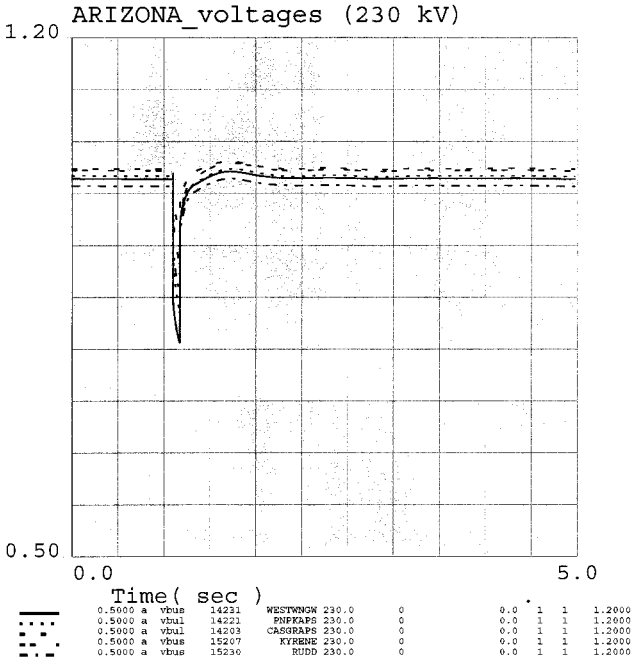

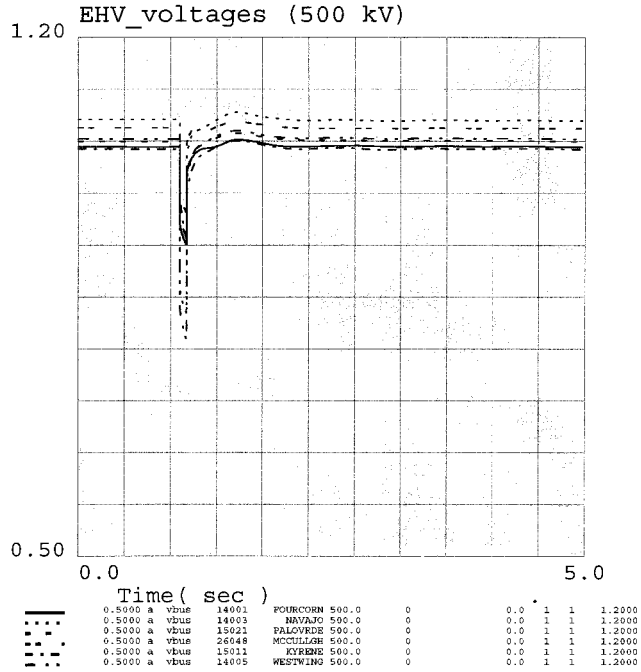

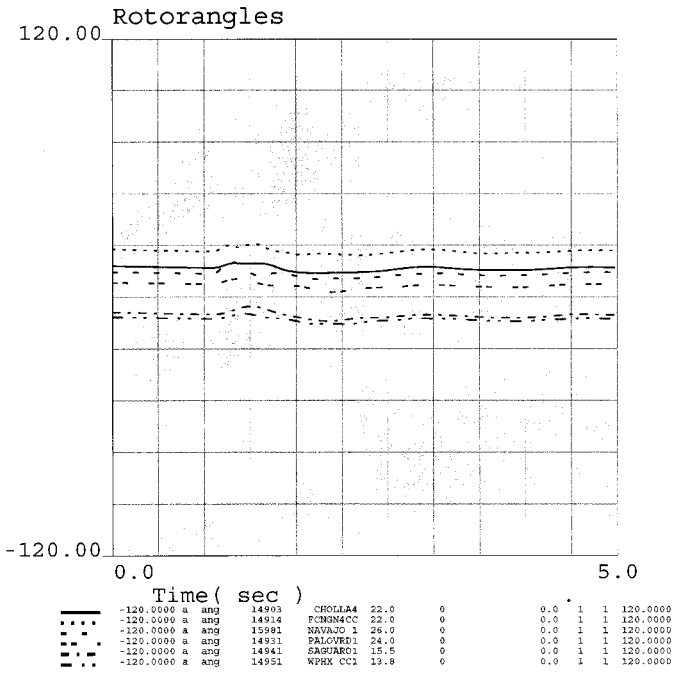

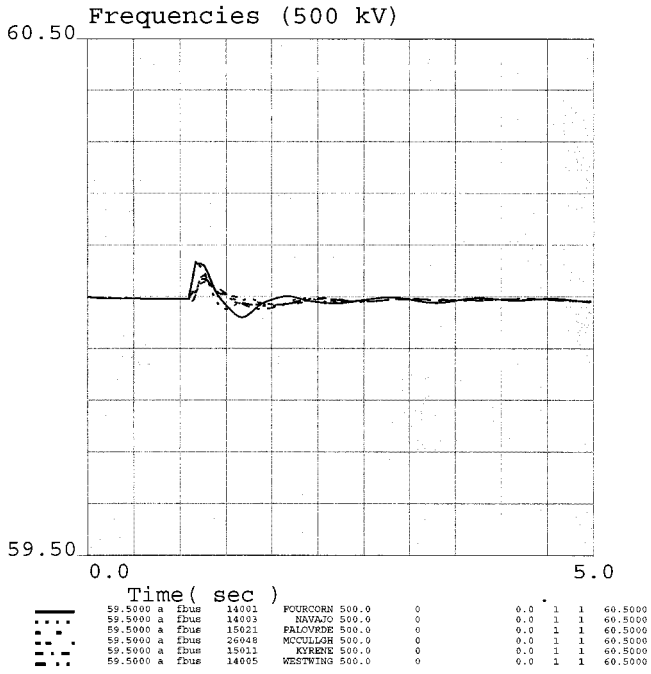

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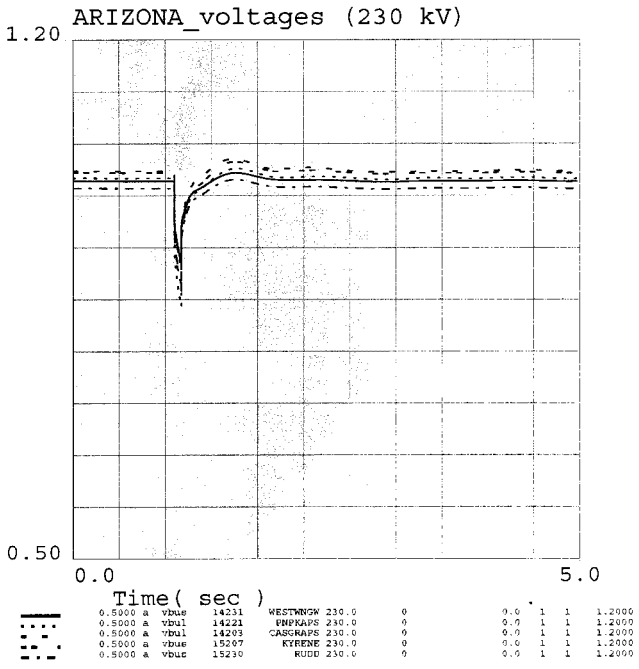

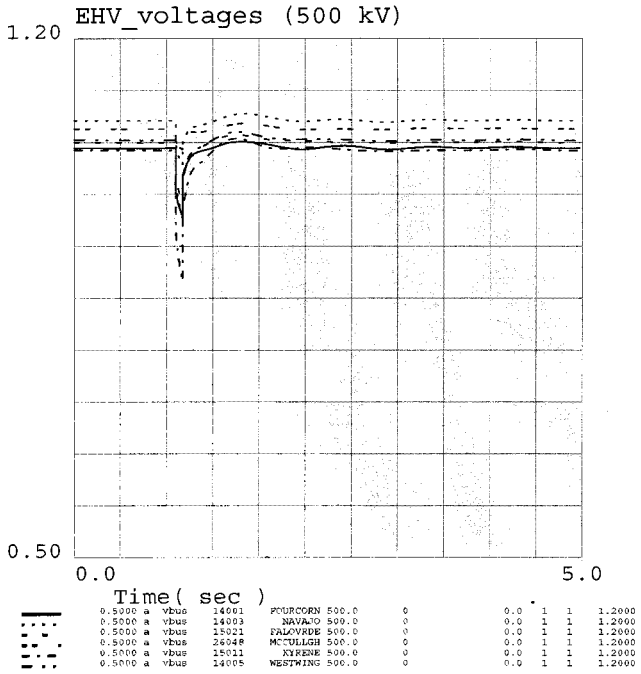

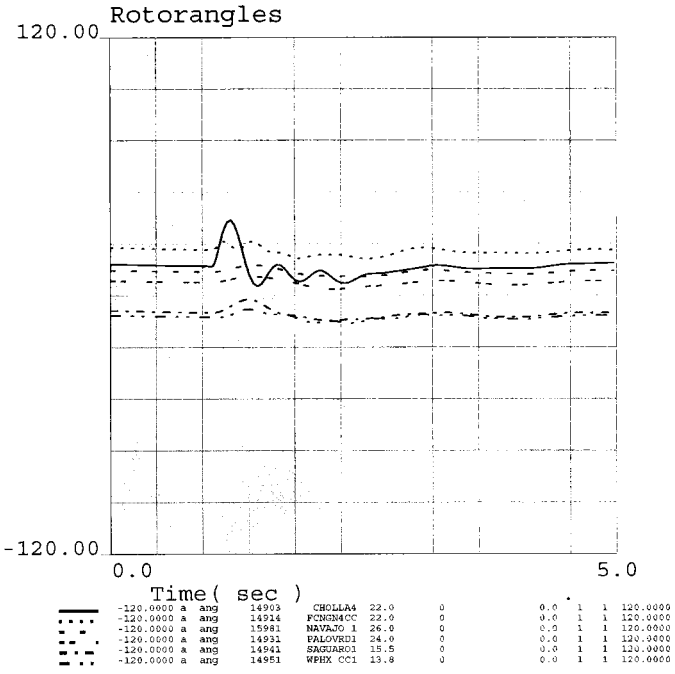

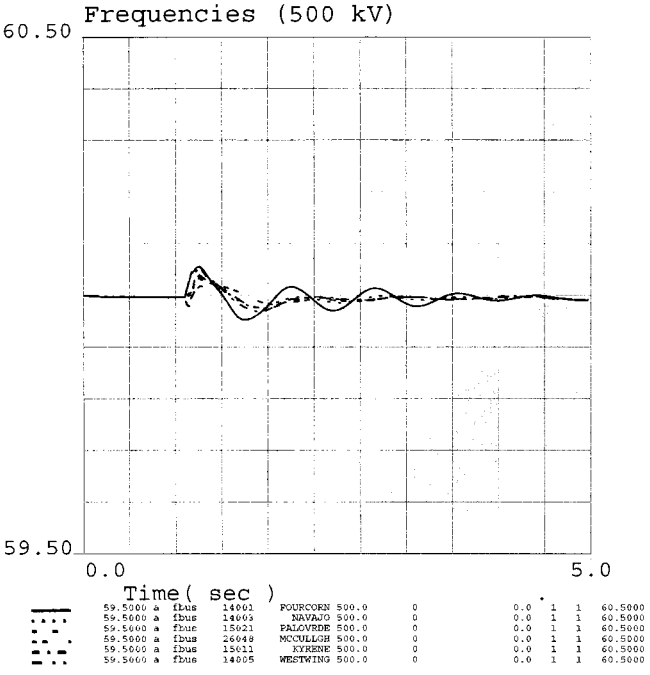

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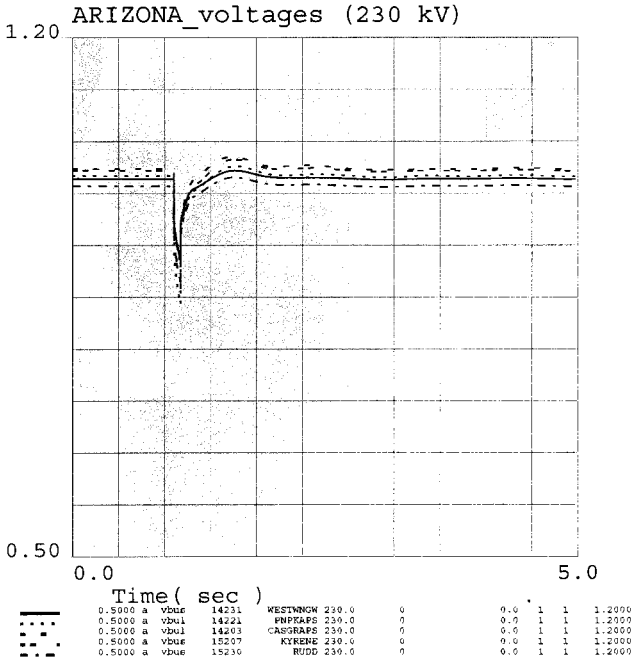

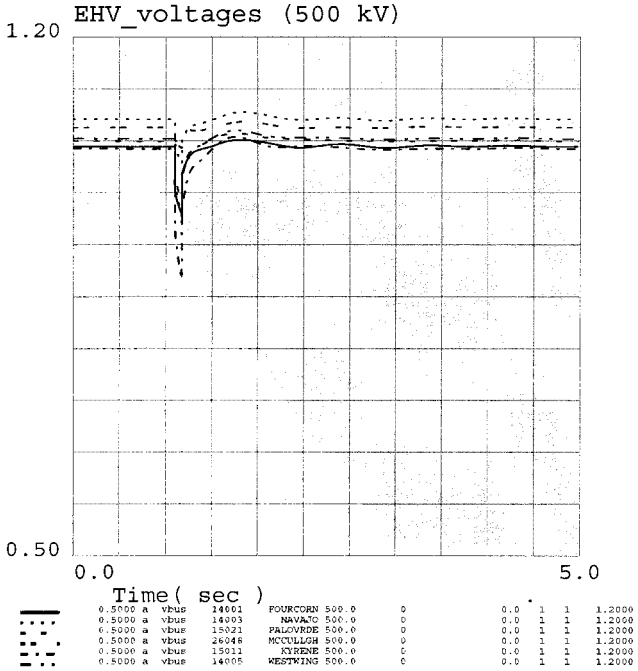

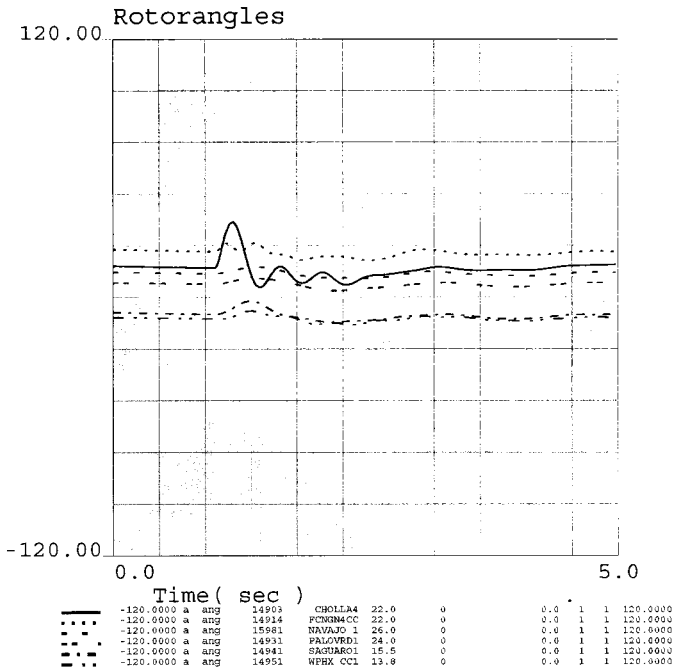

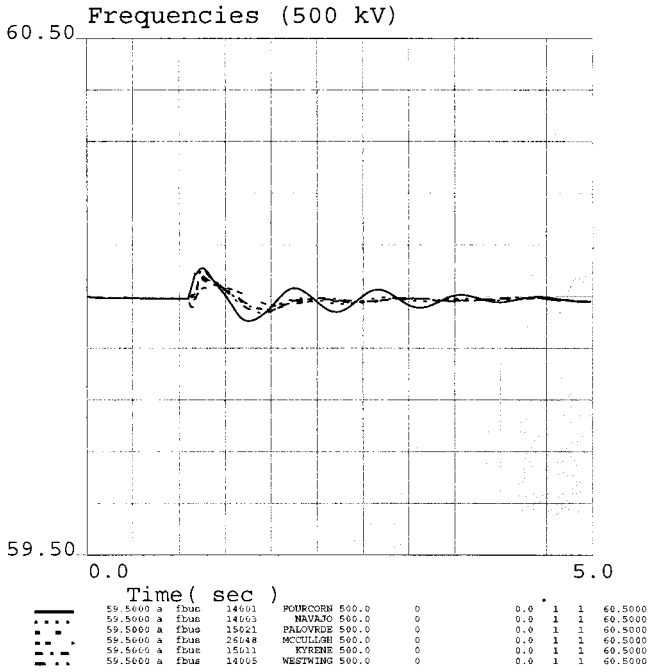

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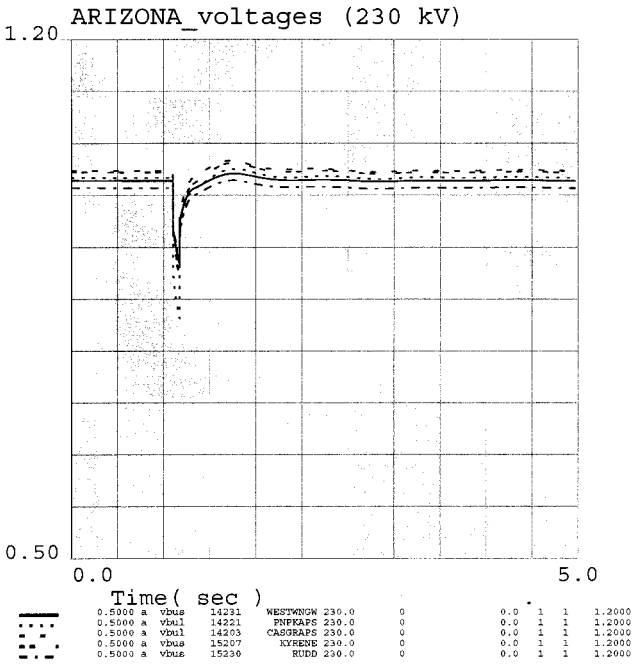

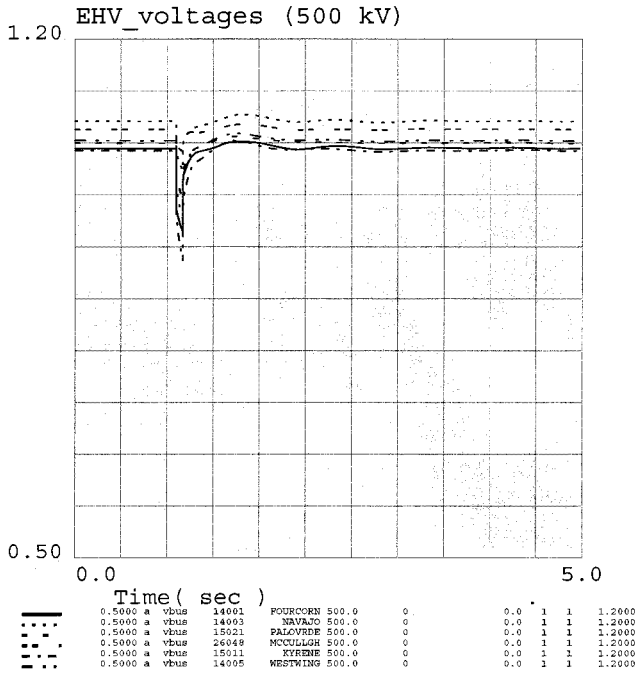

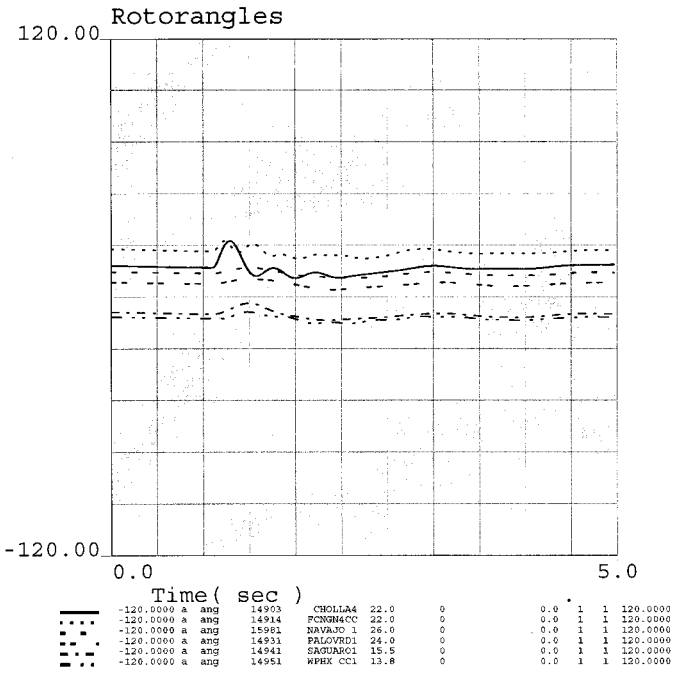

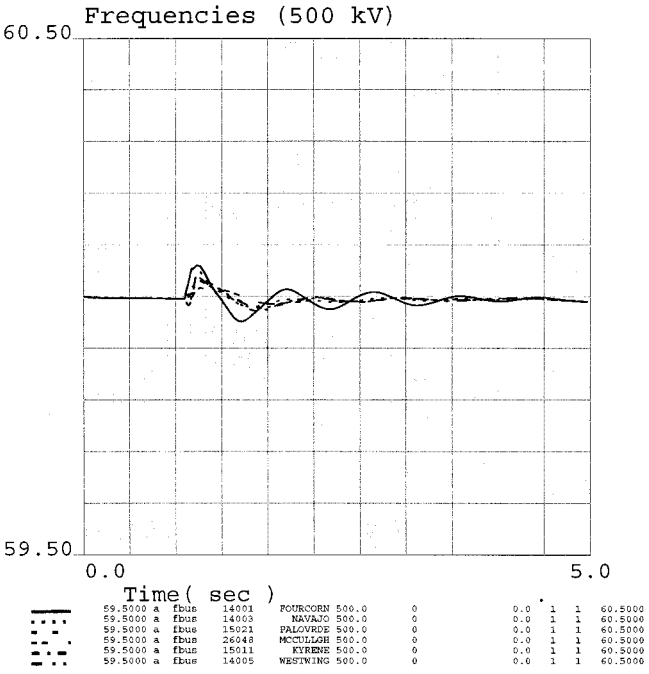

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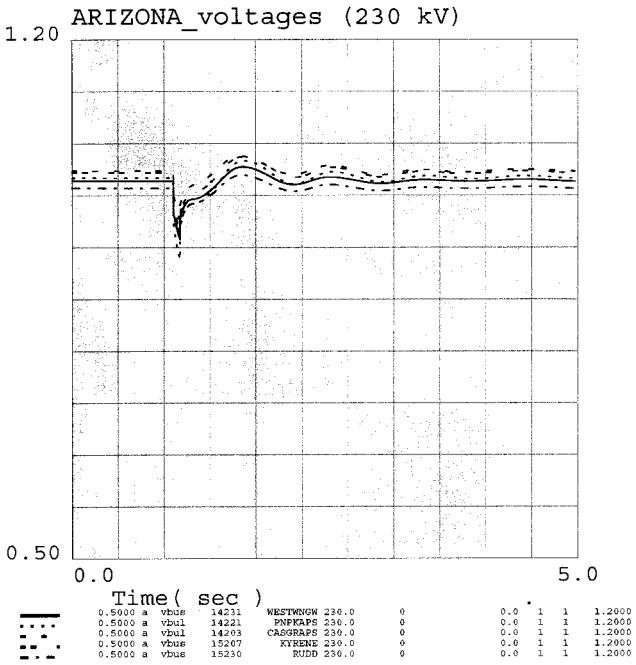

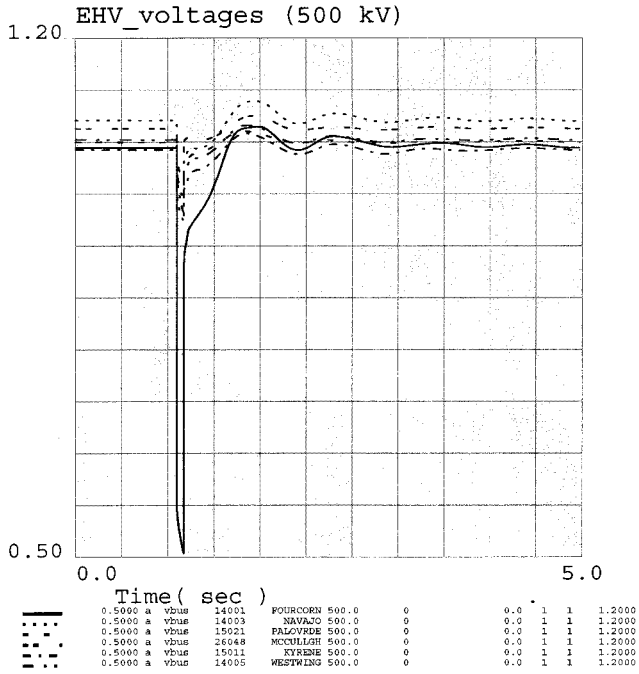

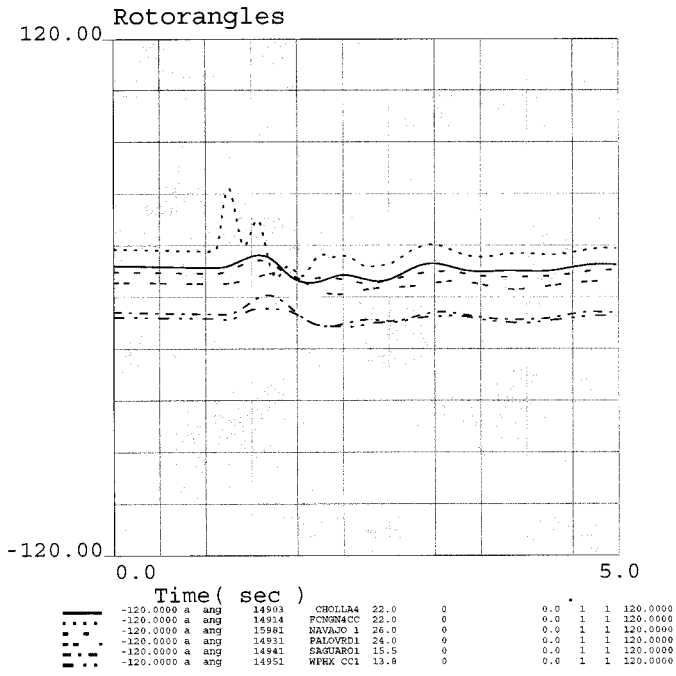

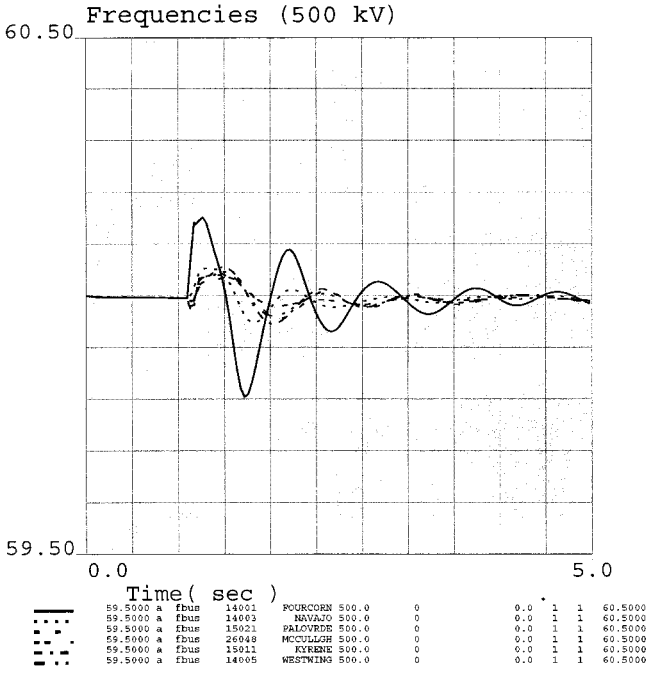

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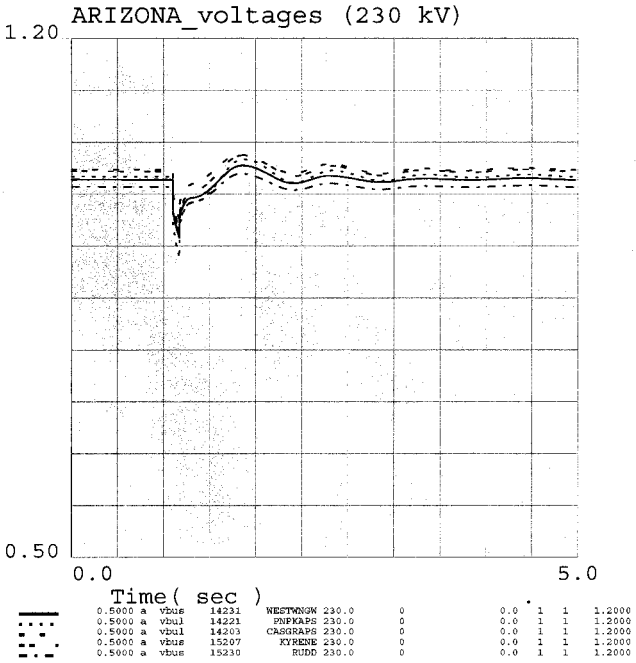

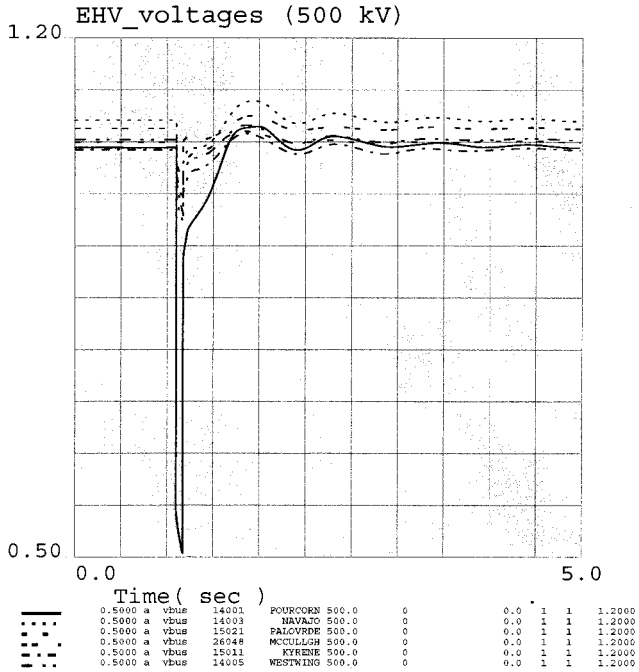

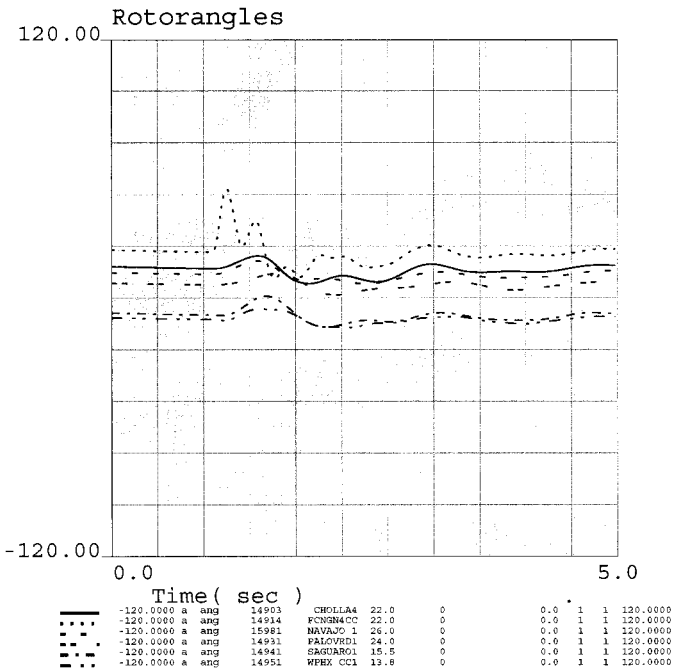

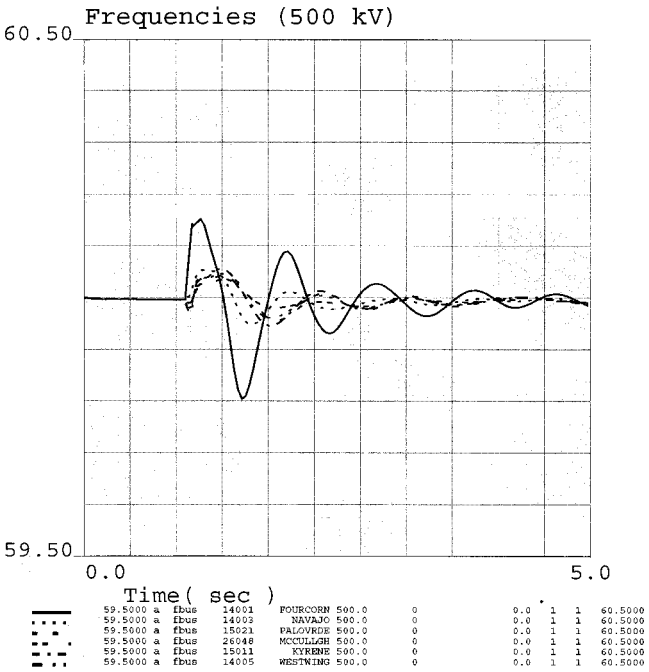

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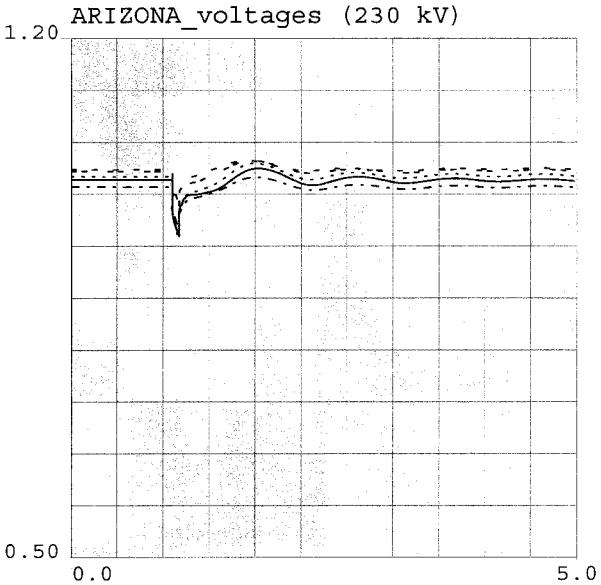

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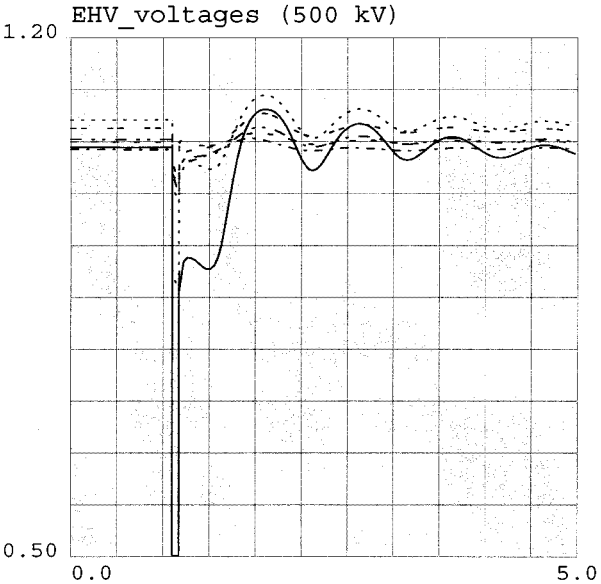
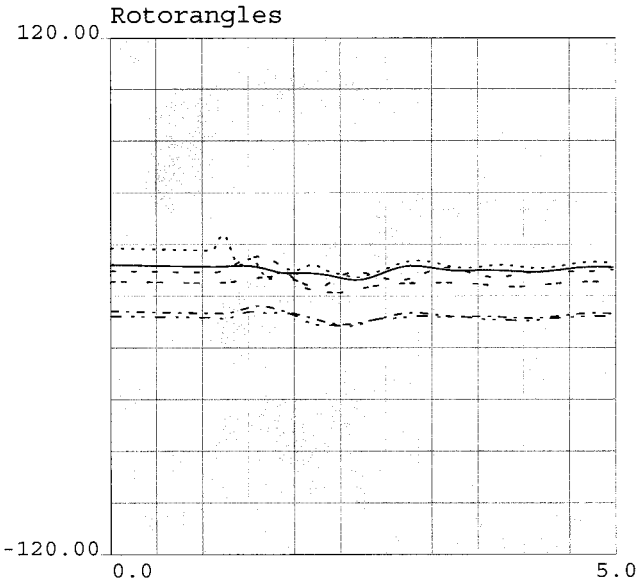
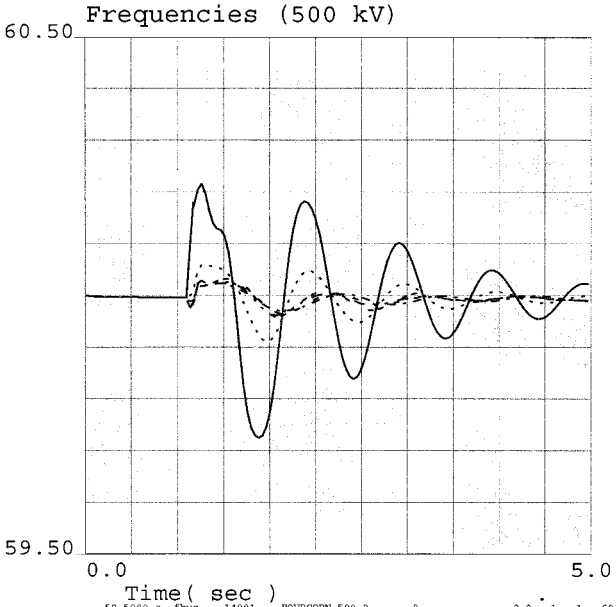
0.5000	a	vbus	14221	PNPYAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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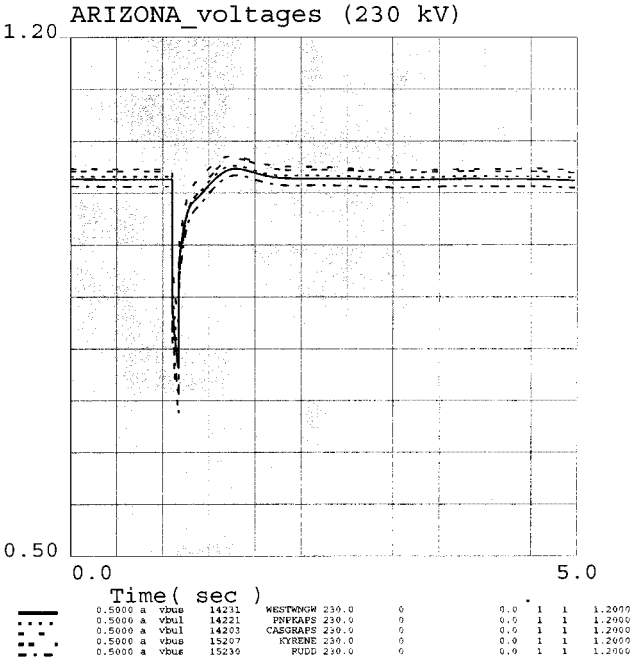

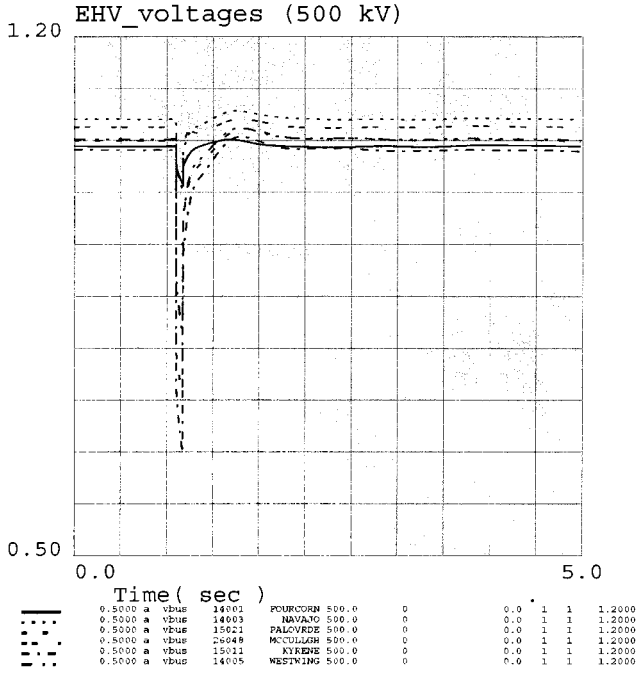

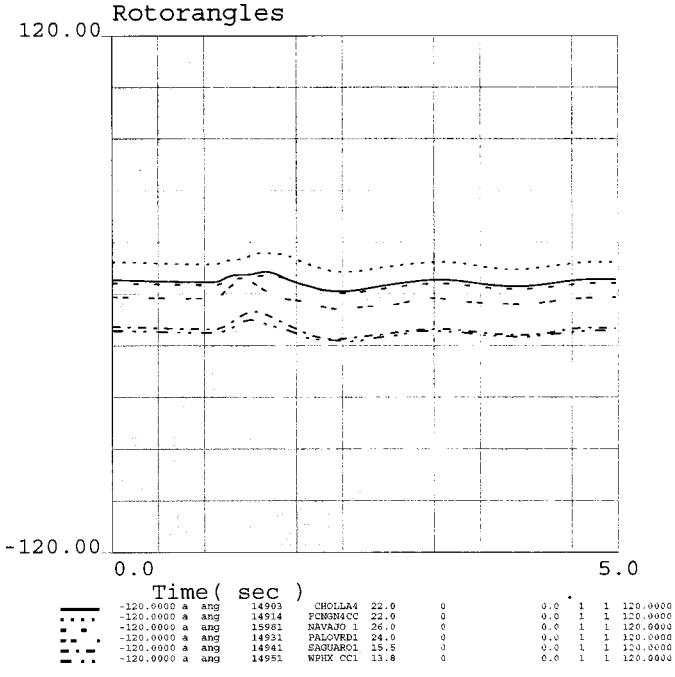

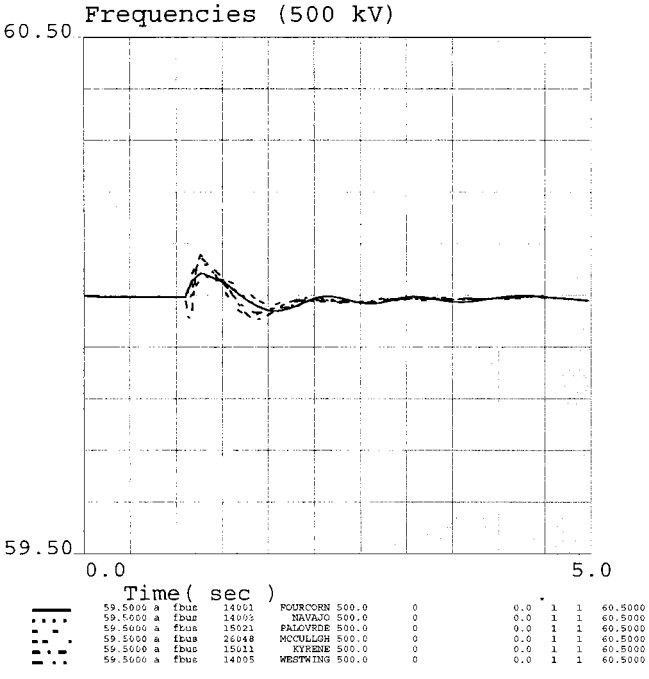

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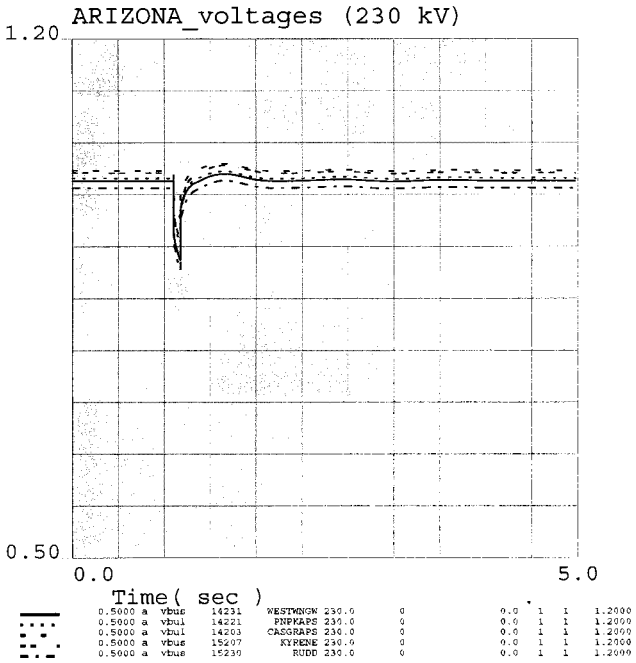

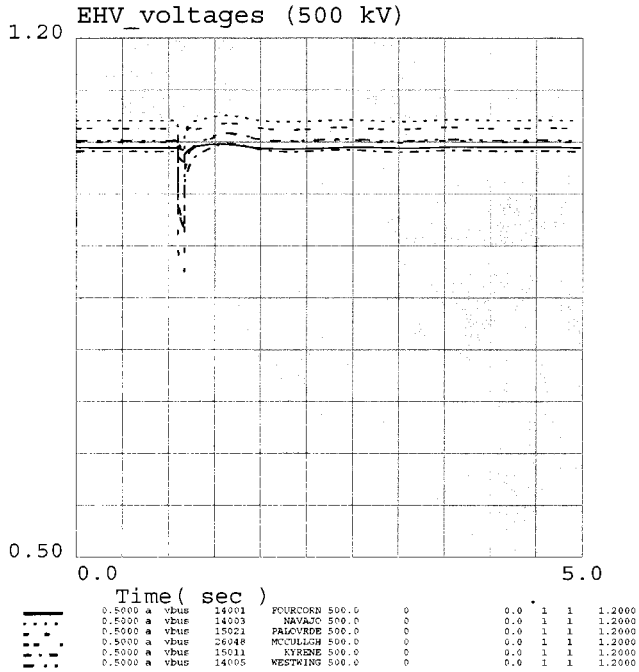

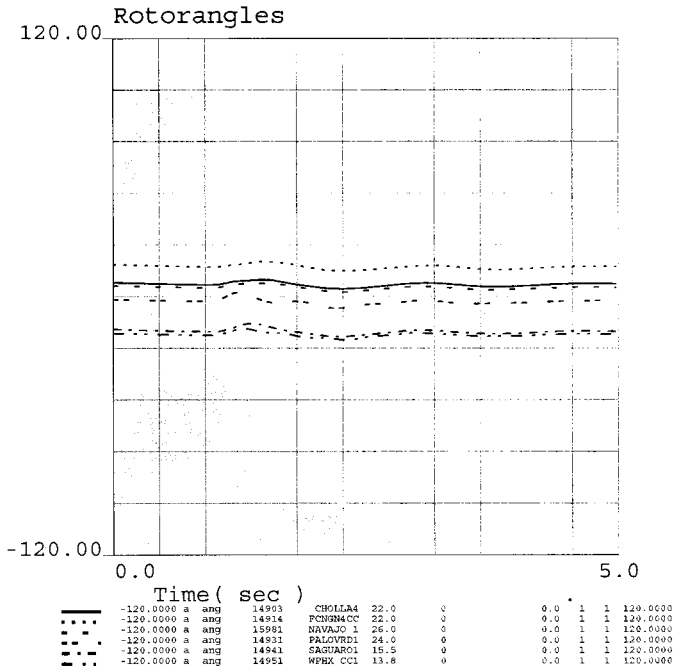

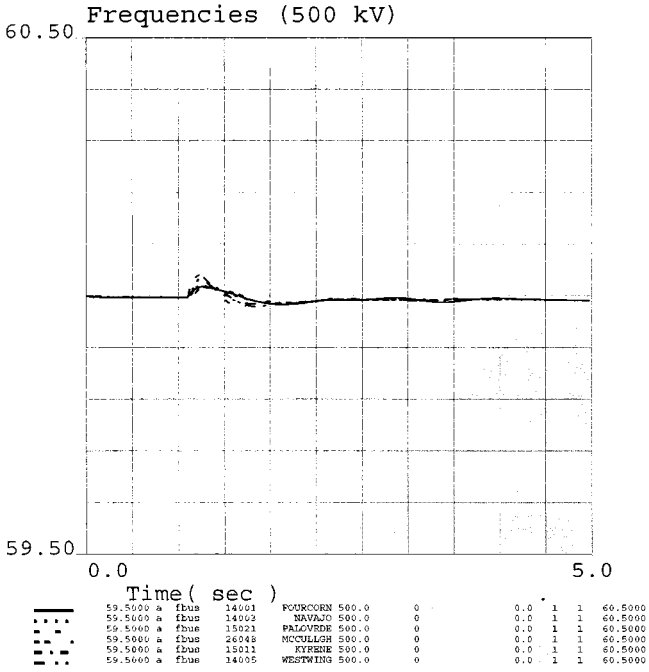

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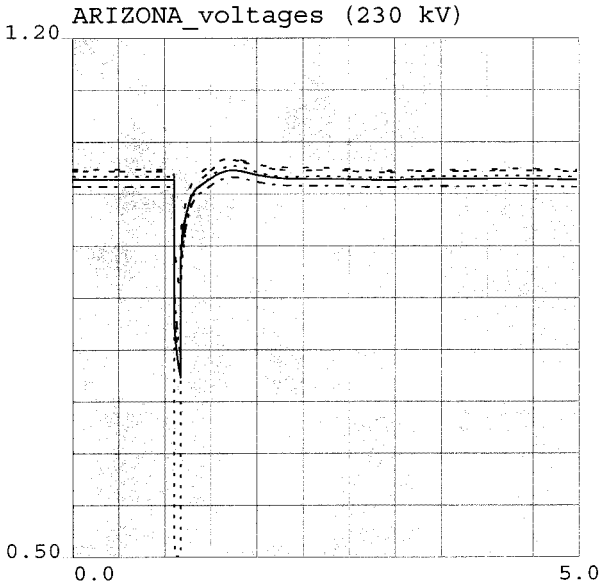
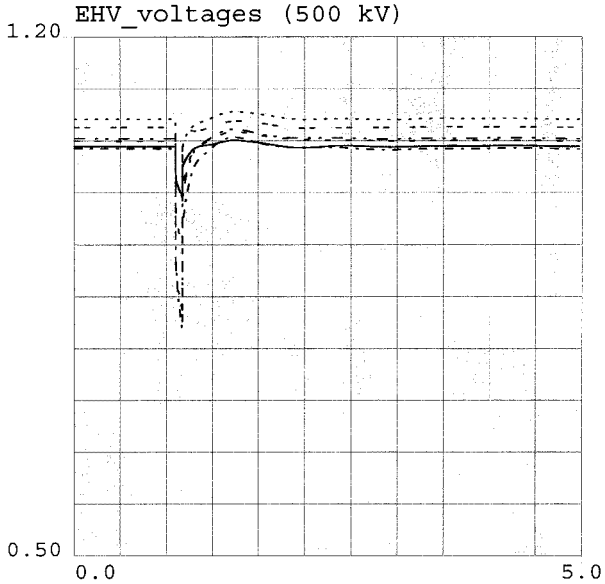
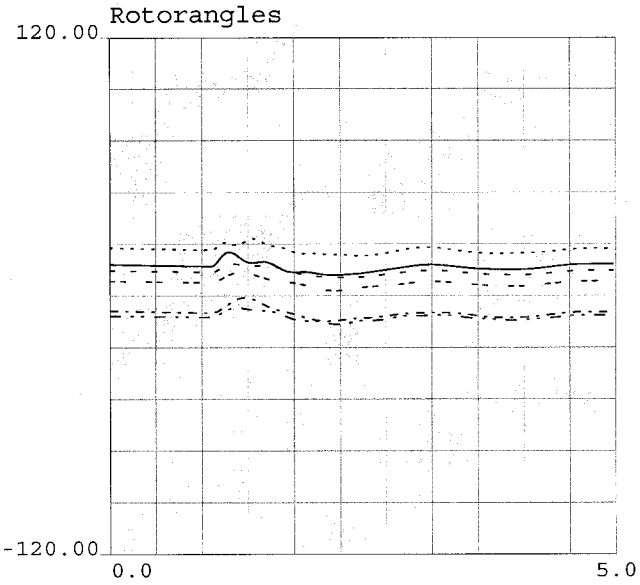


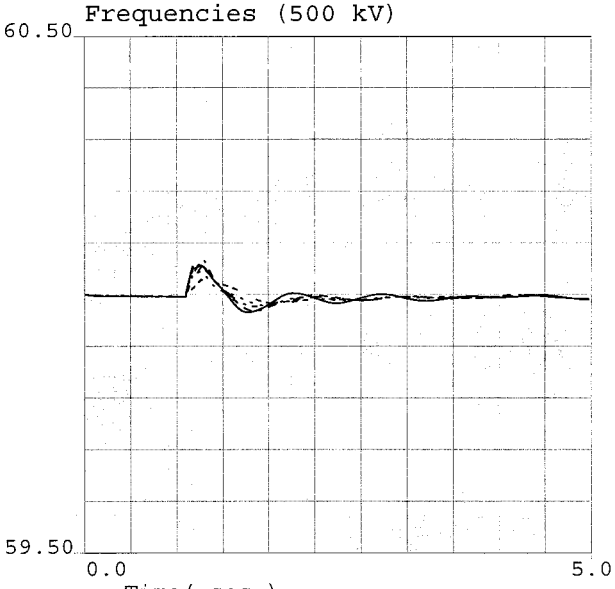
0.5000 a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000 a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000 a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000 a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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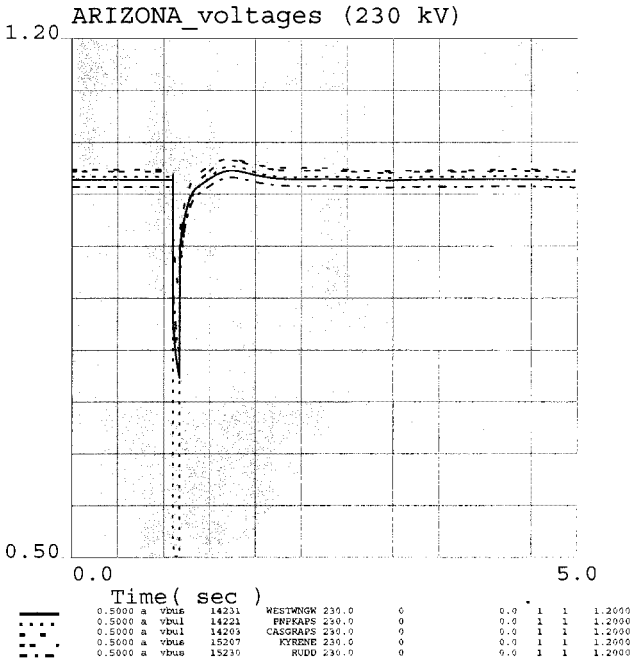

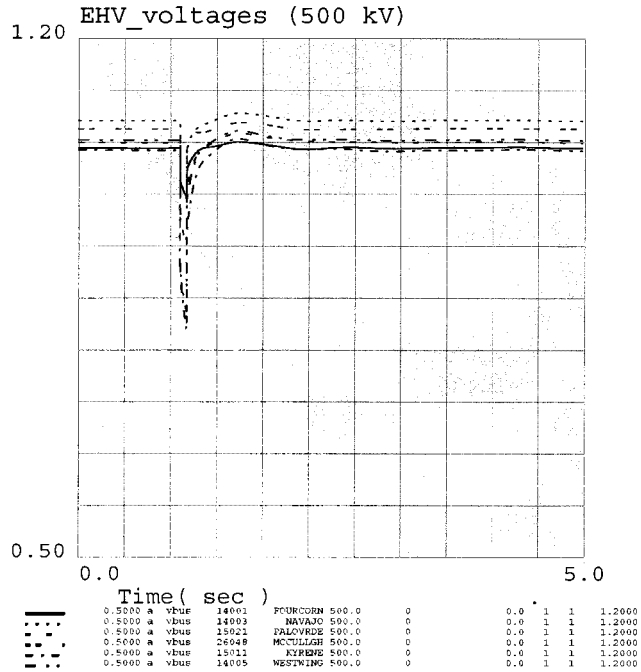

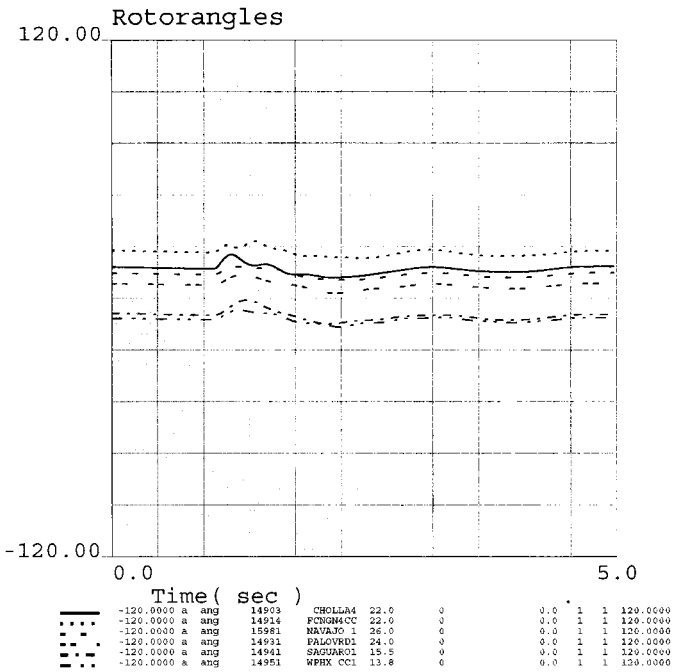

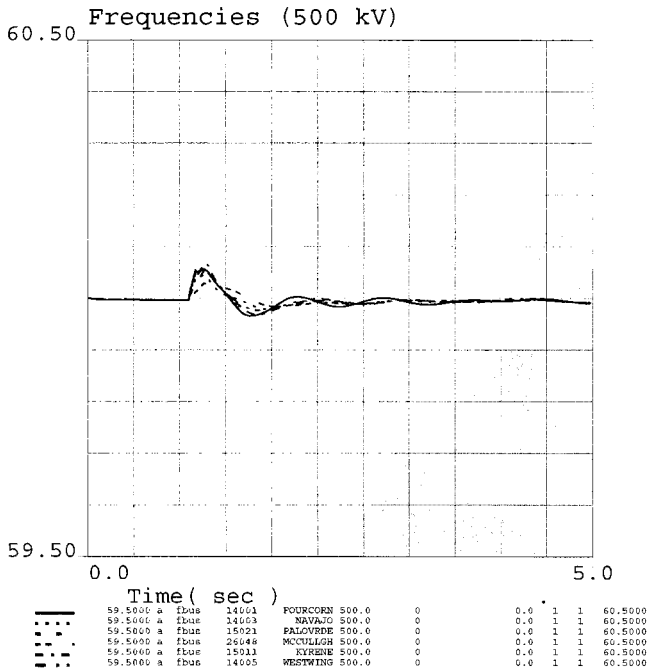

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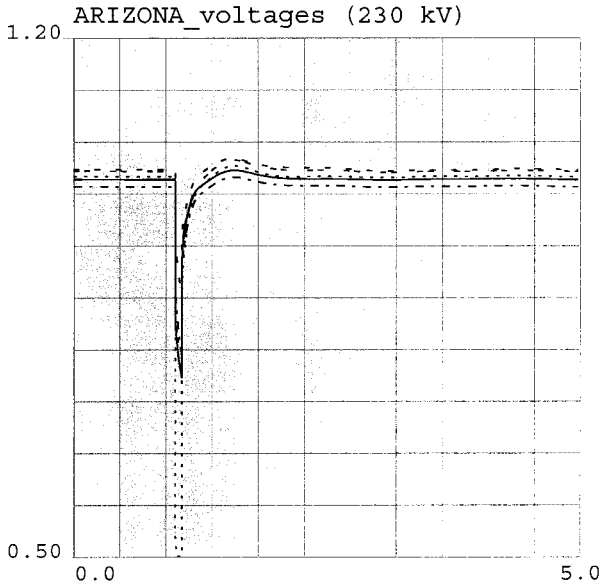

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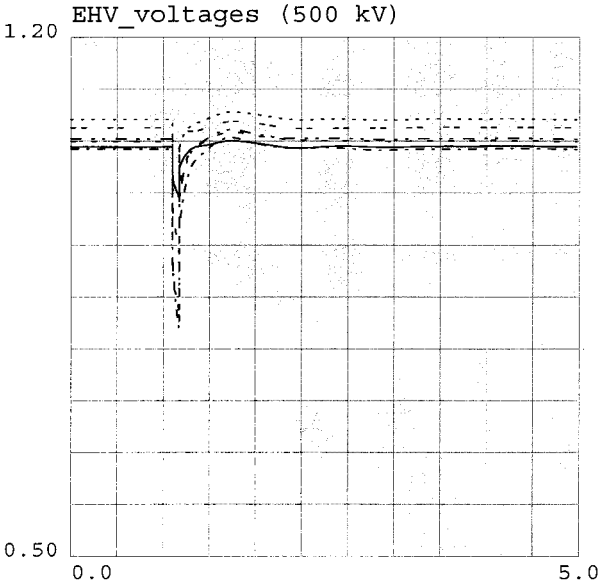
0.5000	a	vbus	14221	PHPEARS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAFS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



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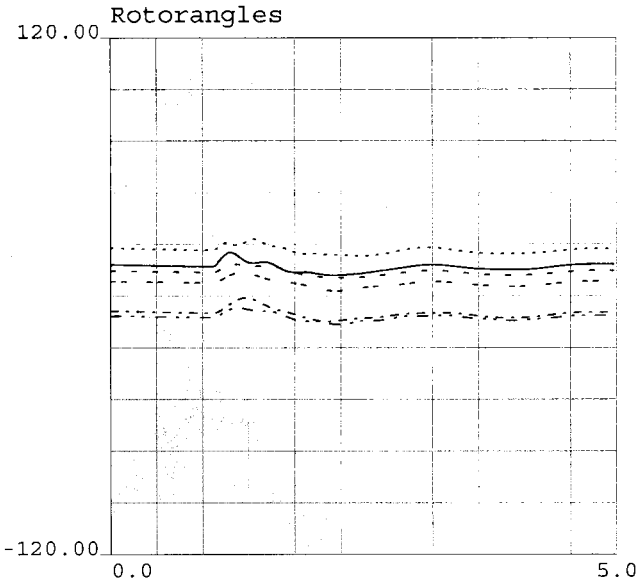
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



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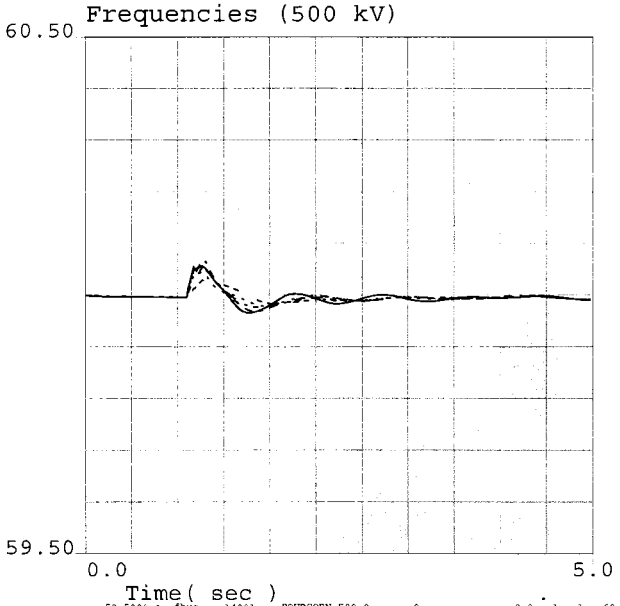
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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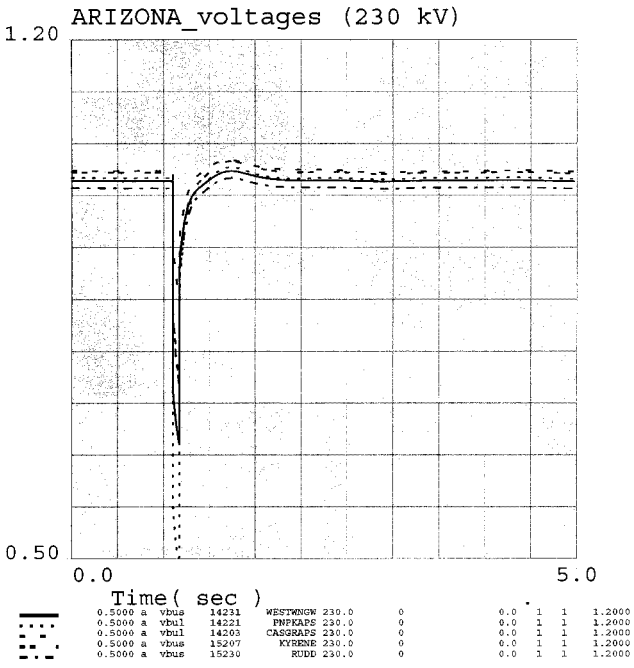

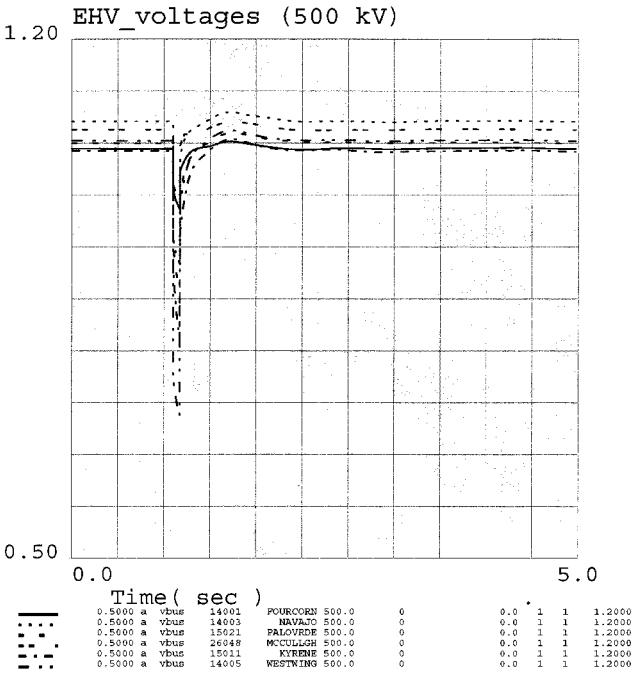

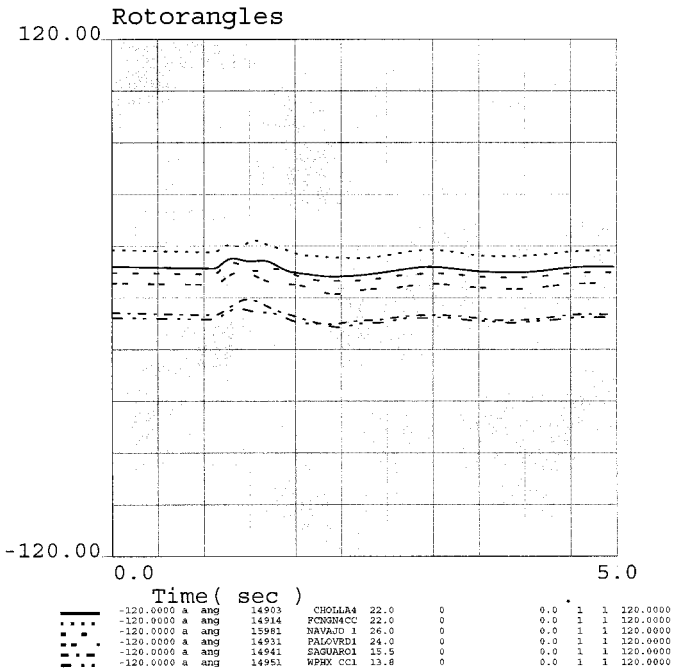

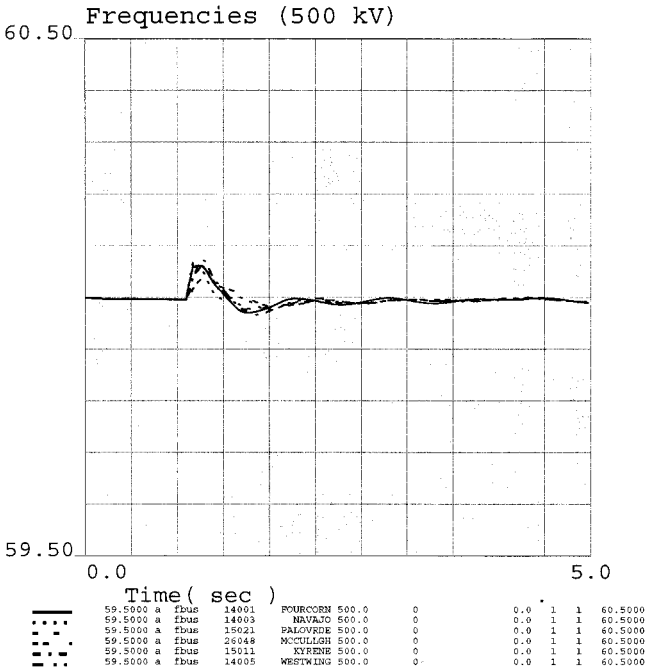

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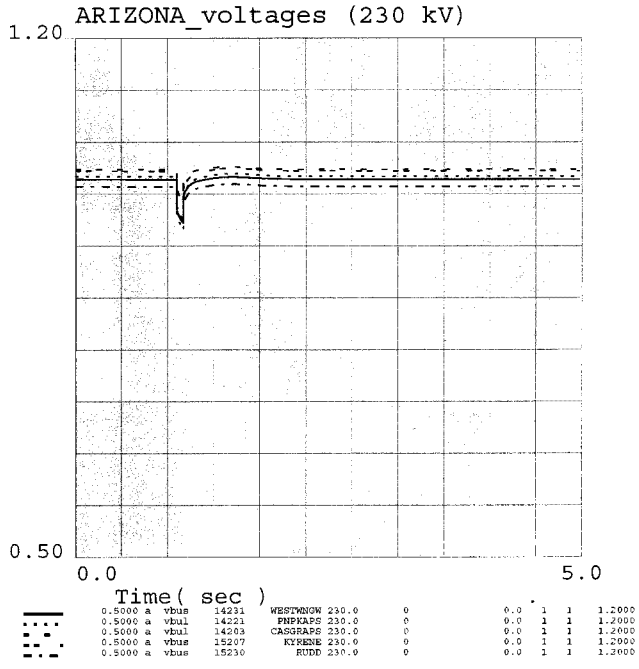

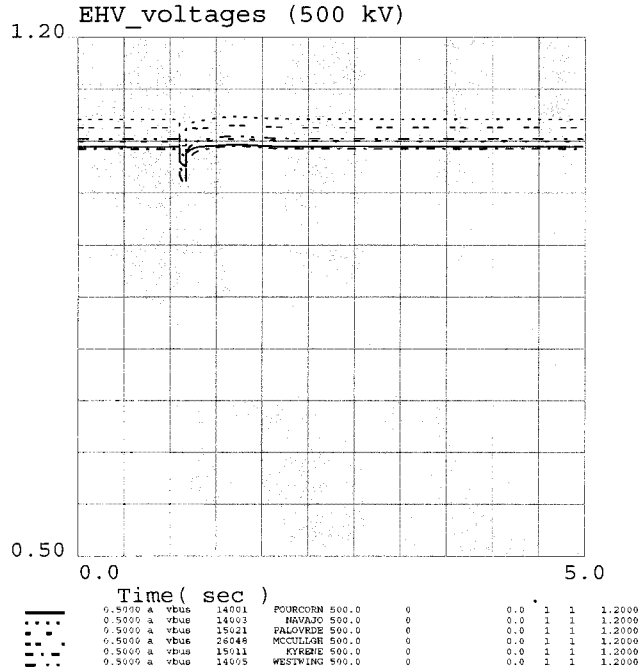

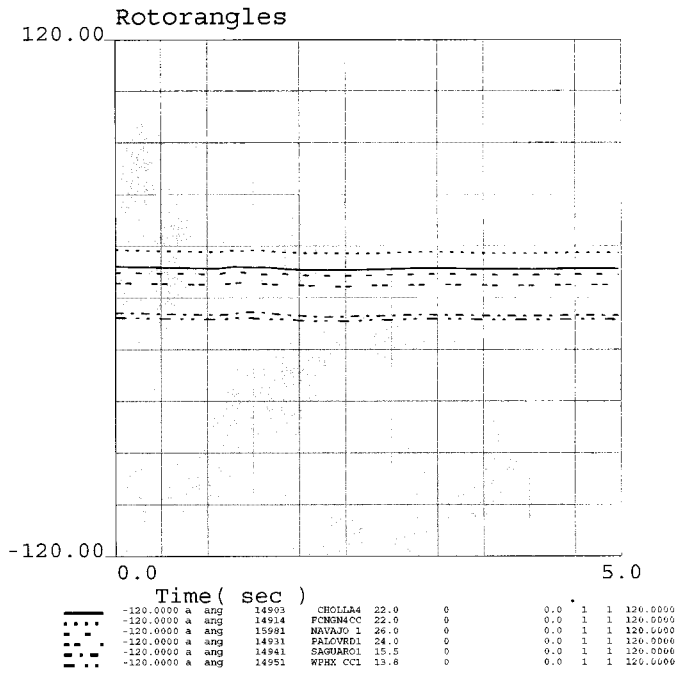

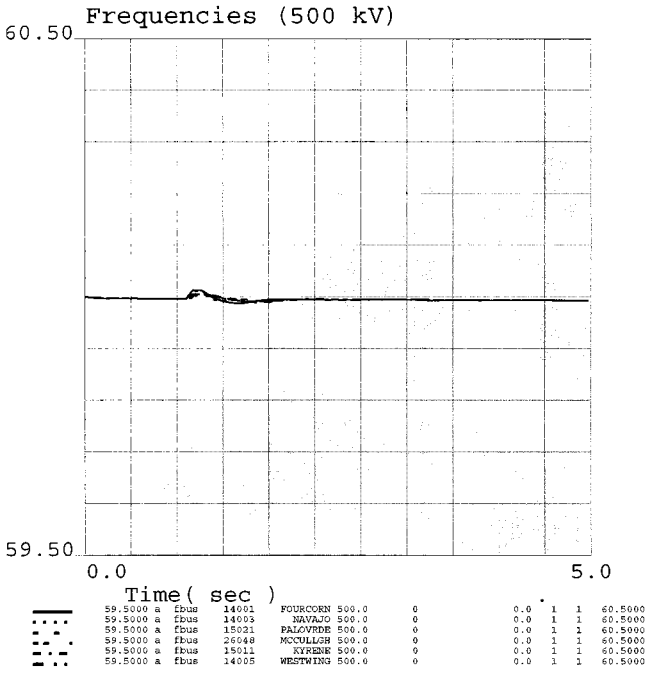

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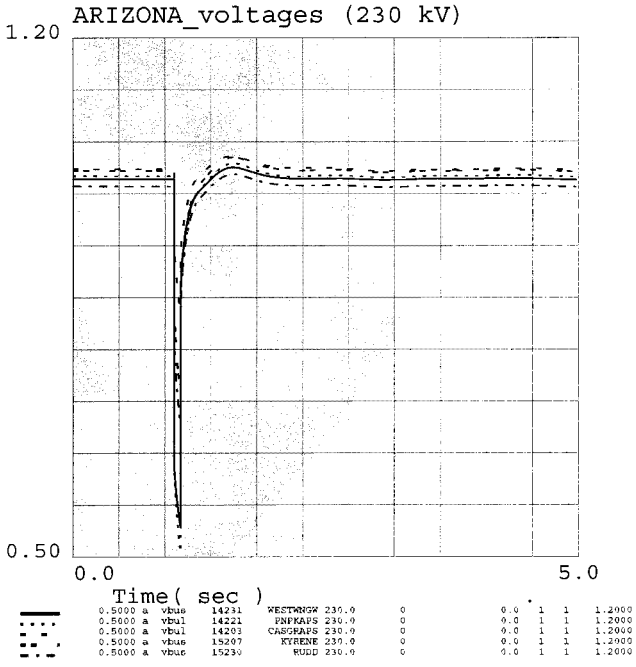

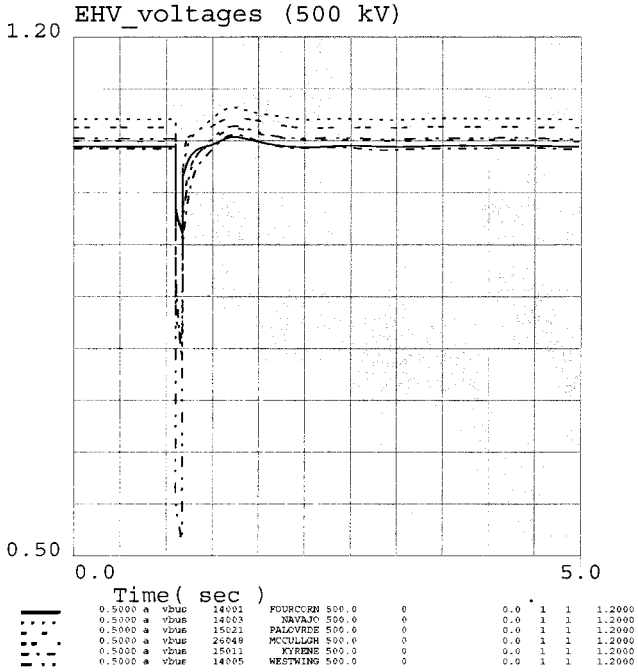

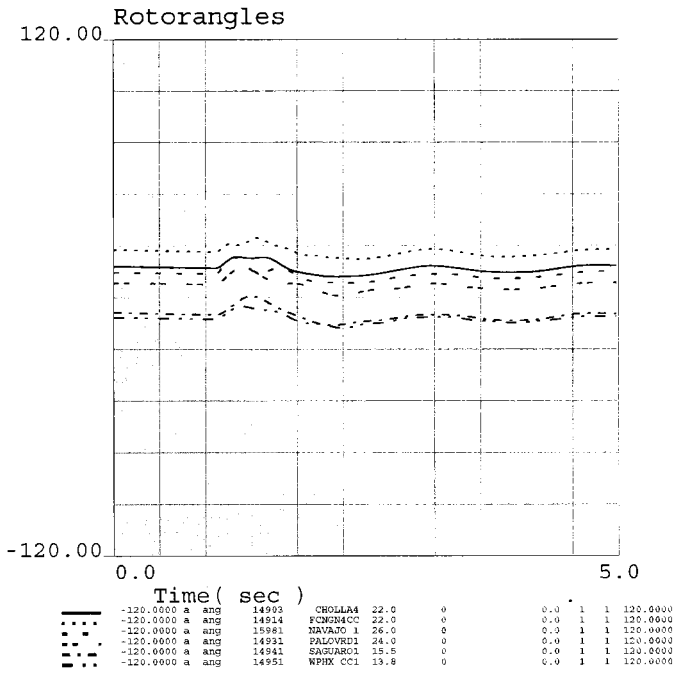

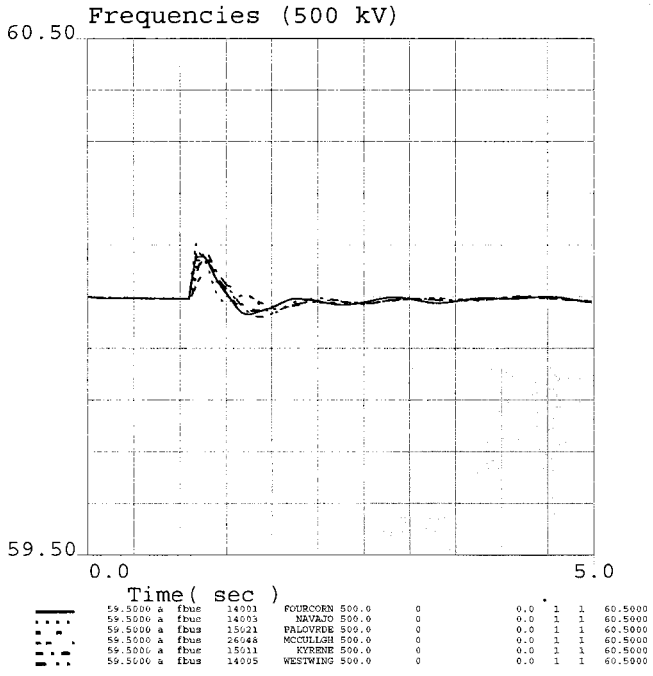

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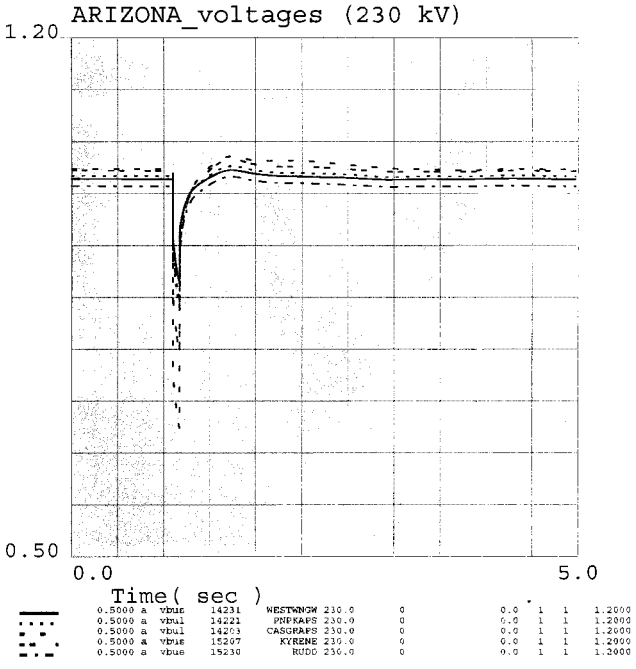

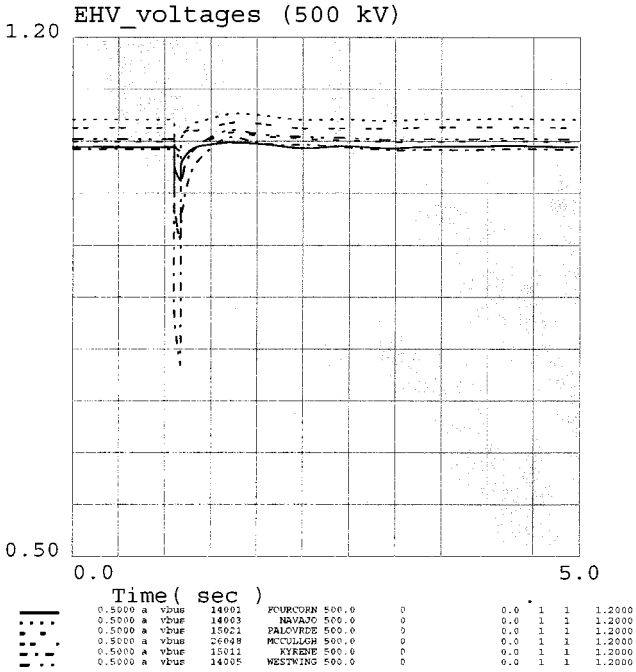

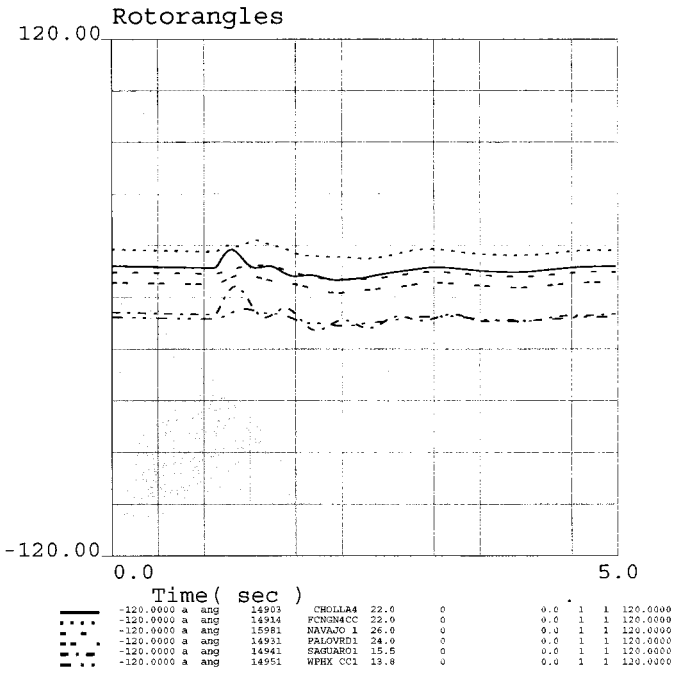

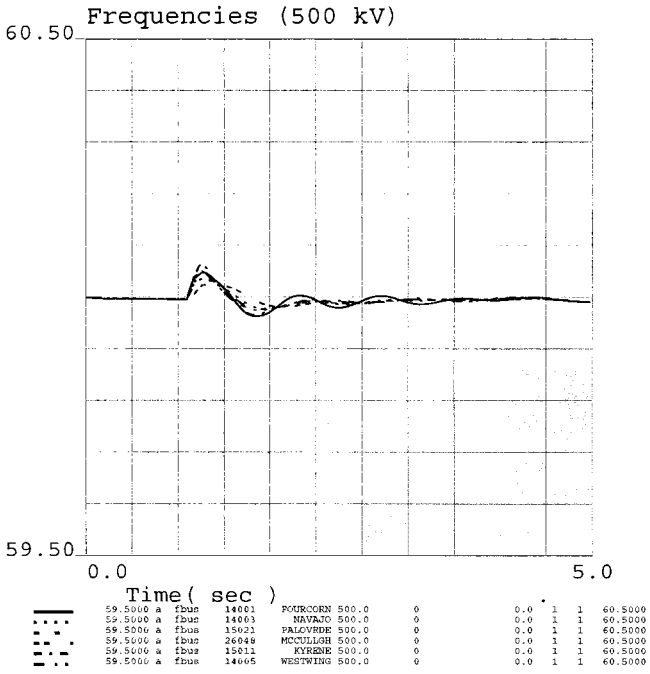

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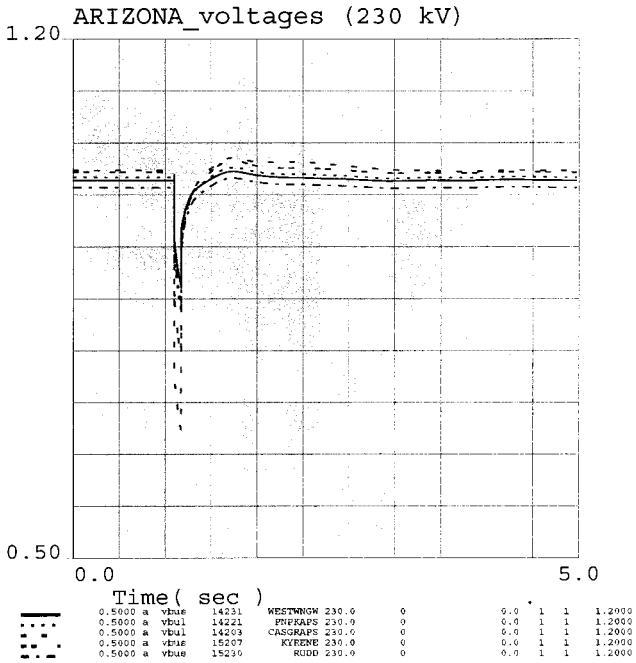

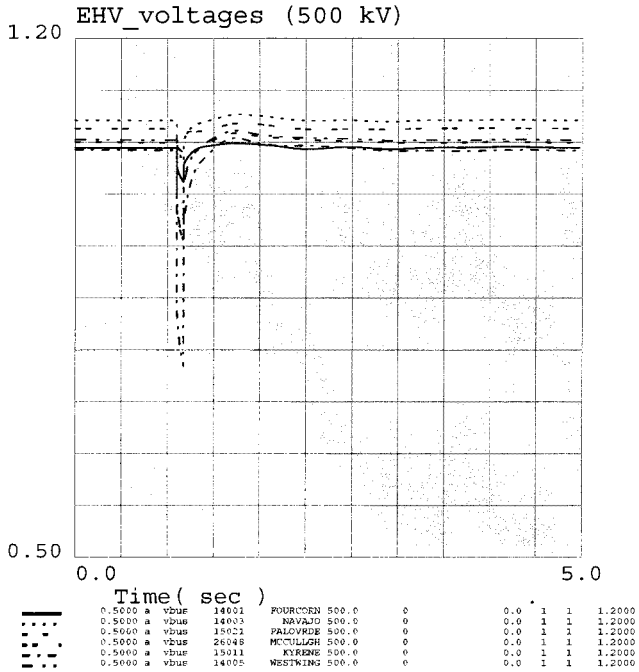

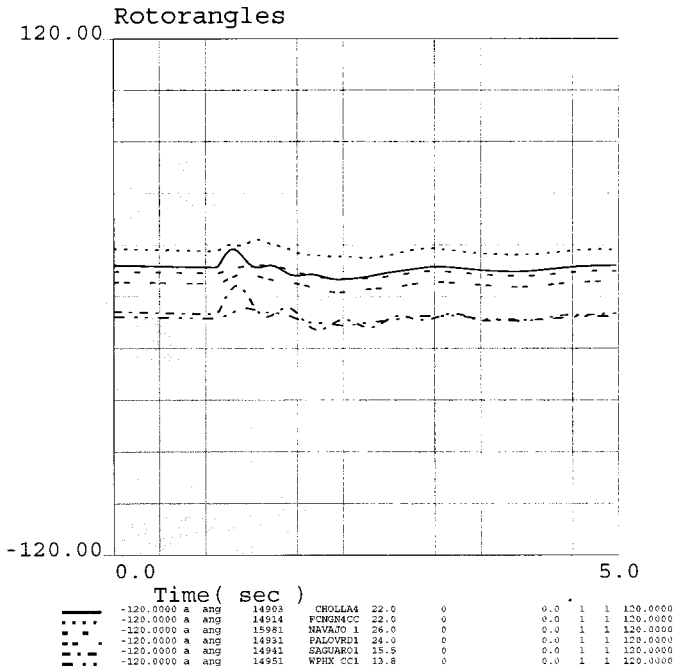

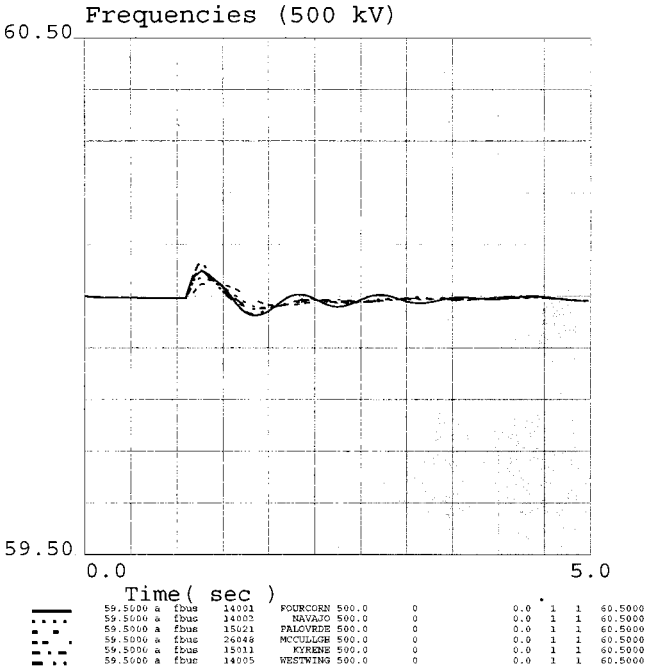

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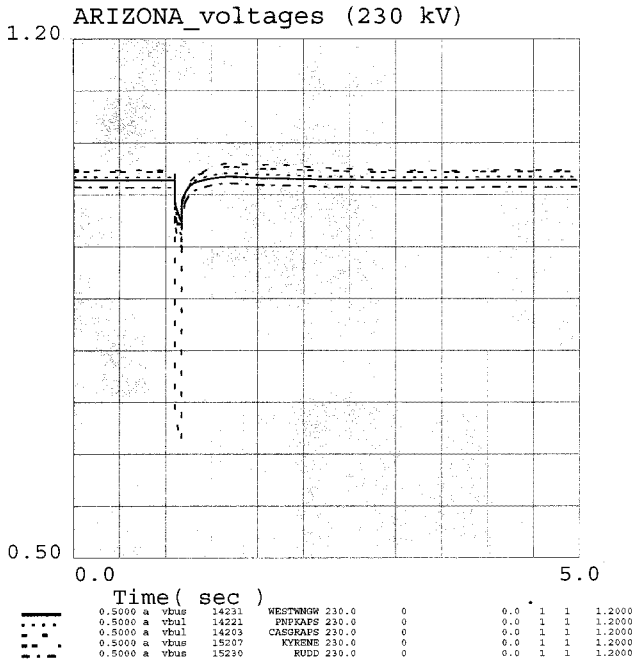

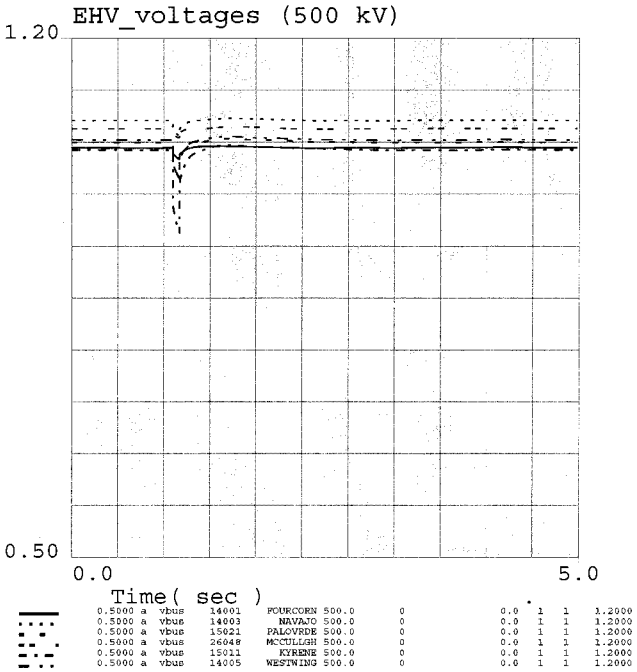

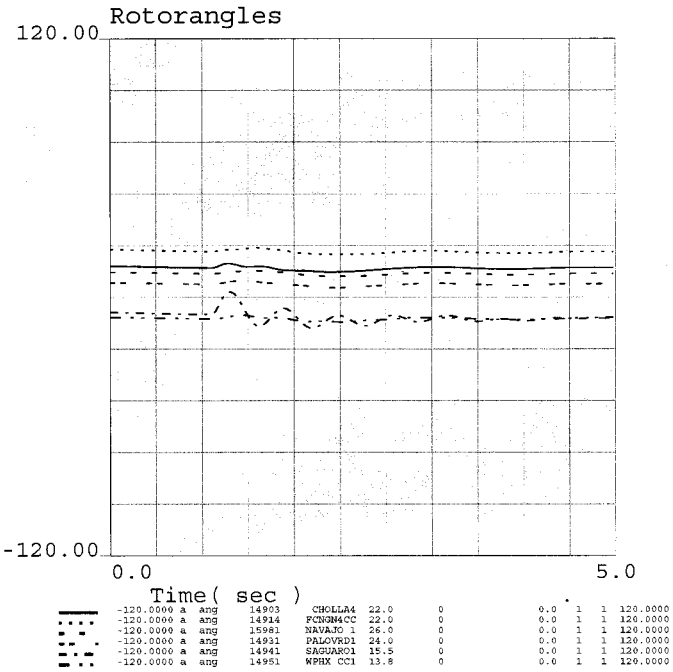

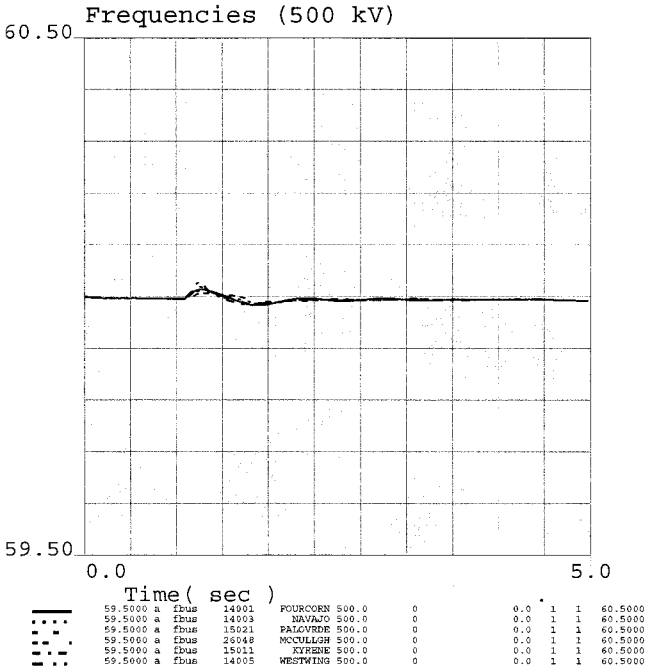

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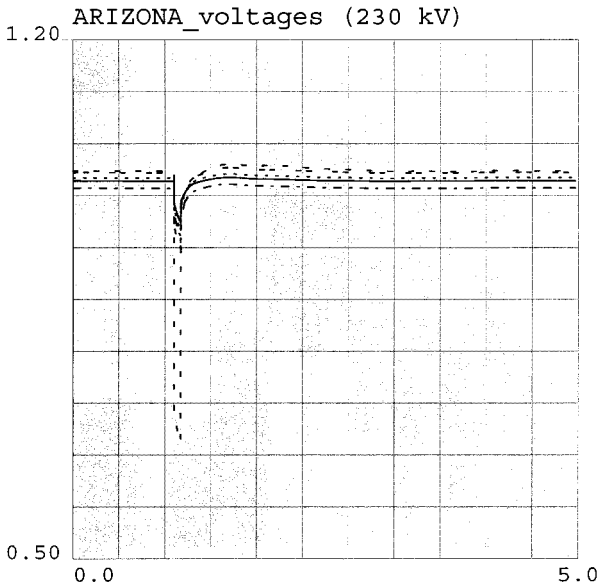
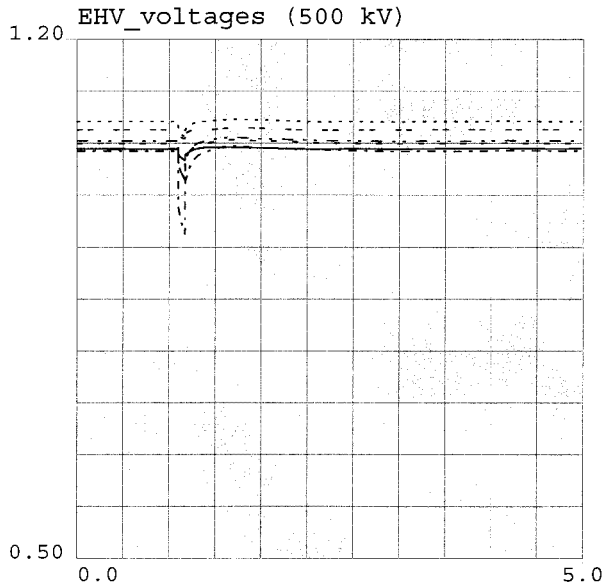
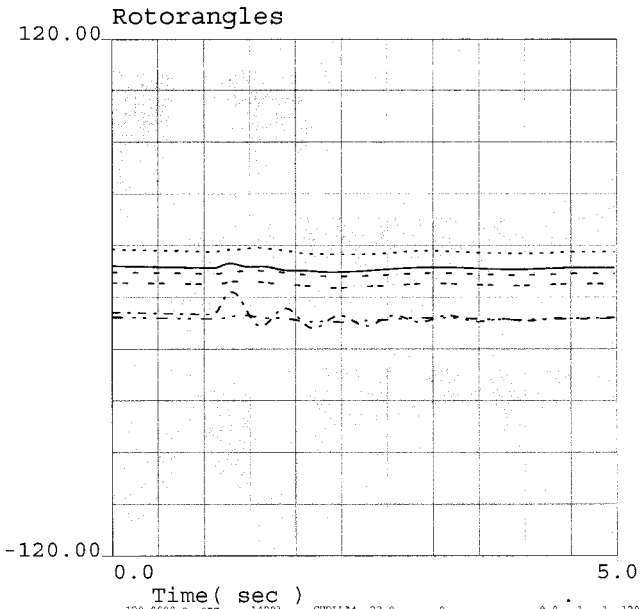


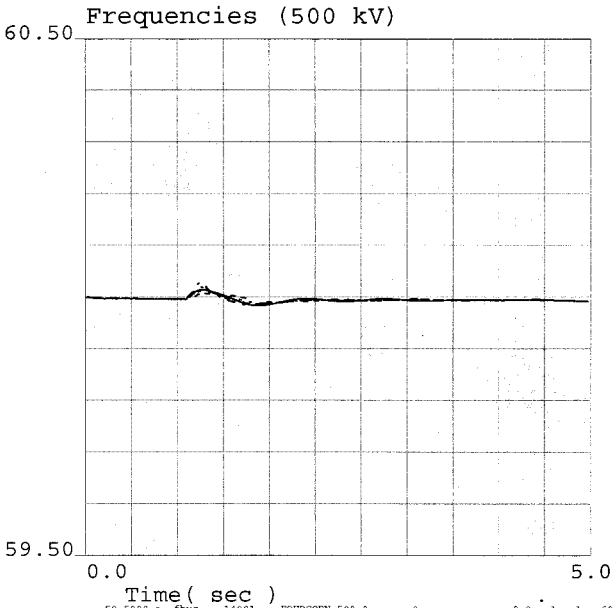
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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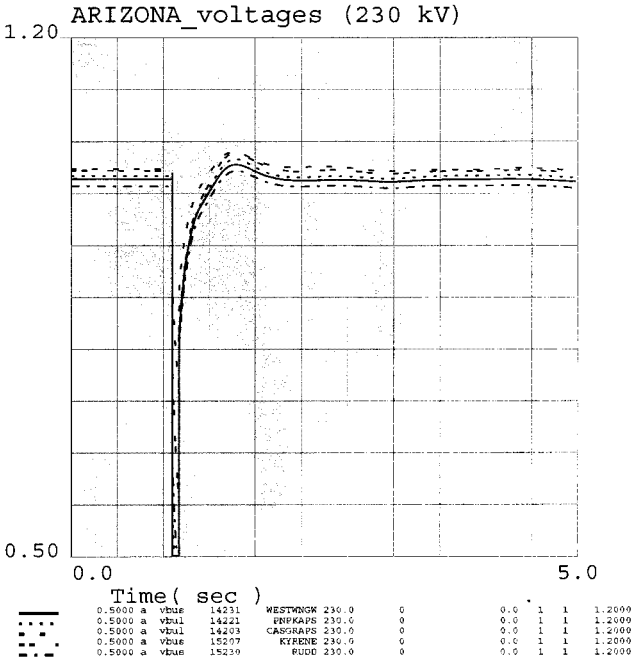

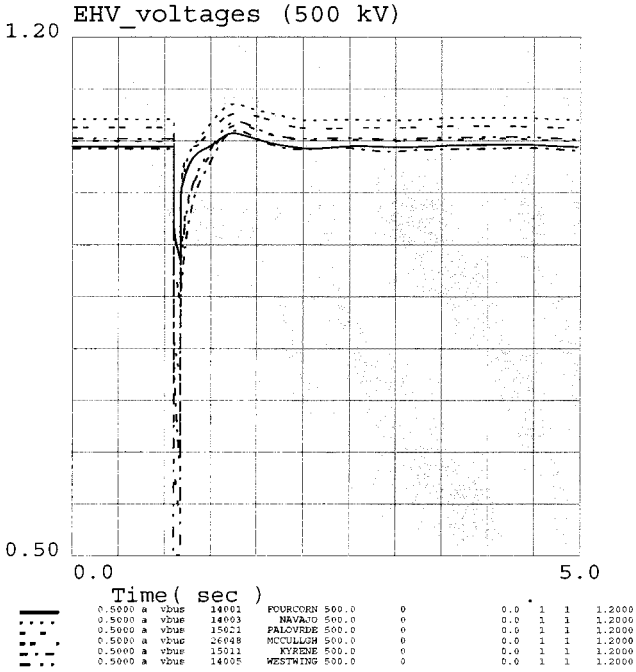

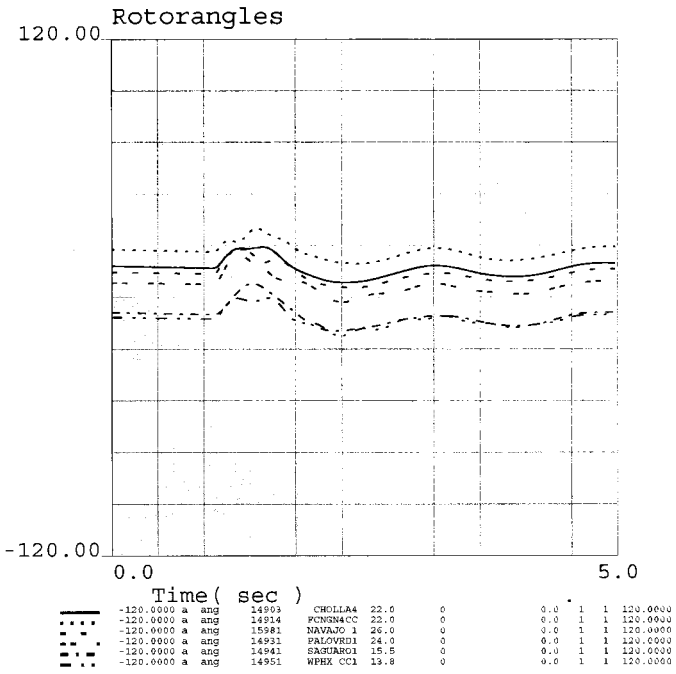

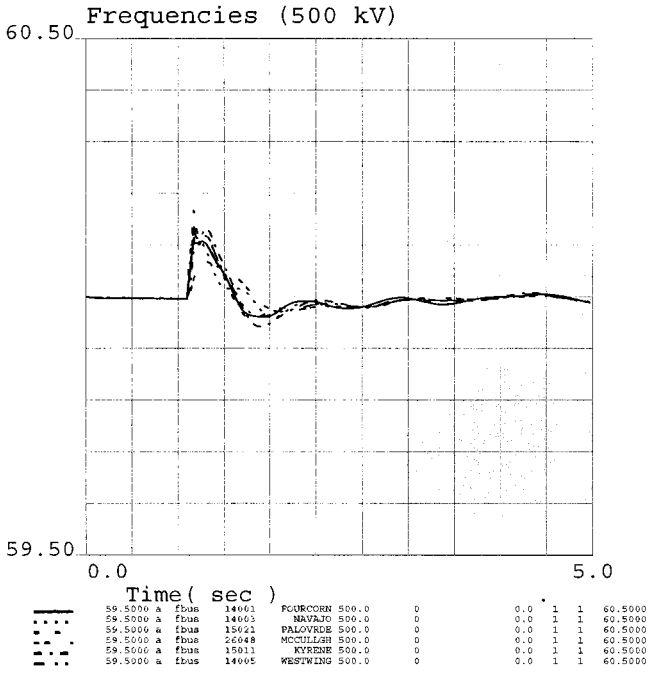

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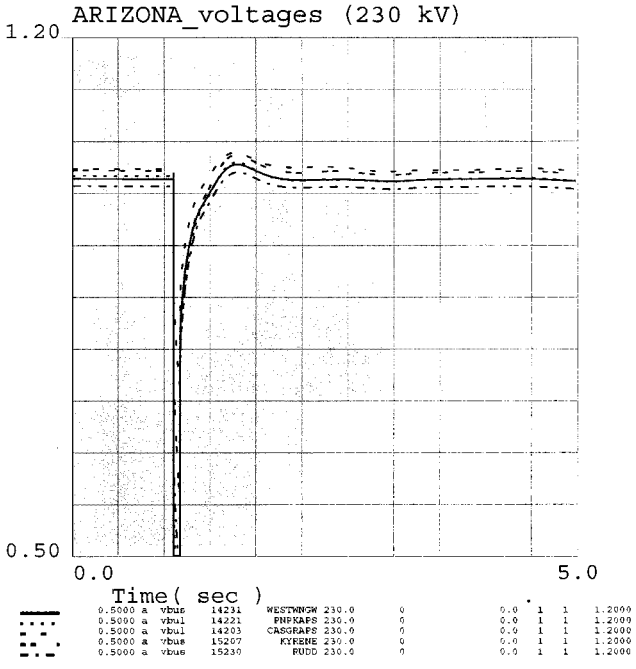

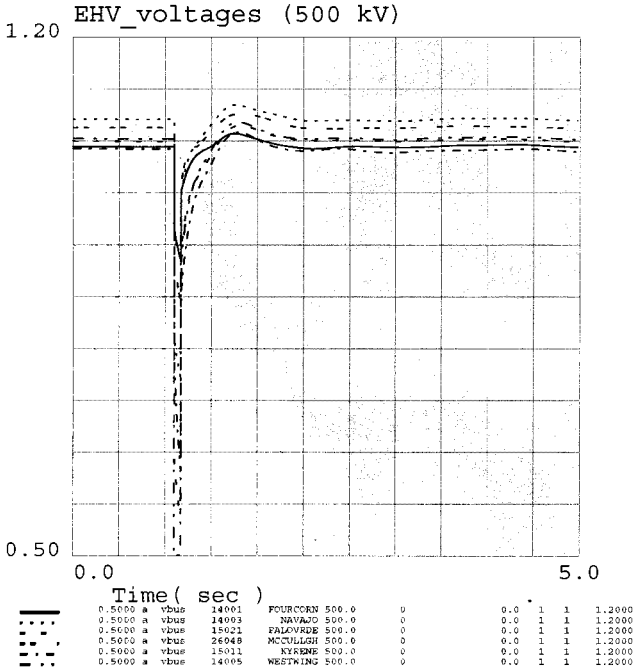

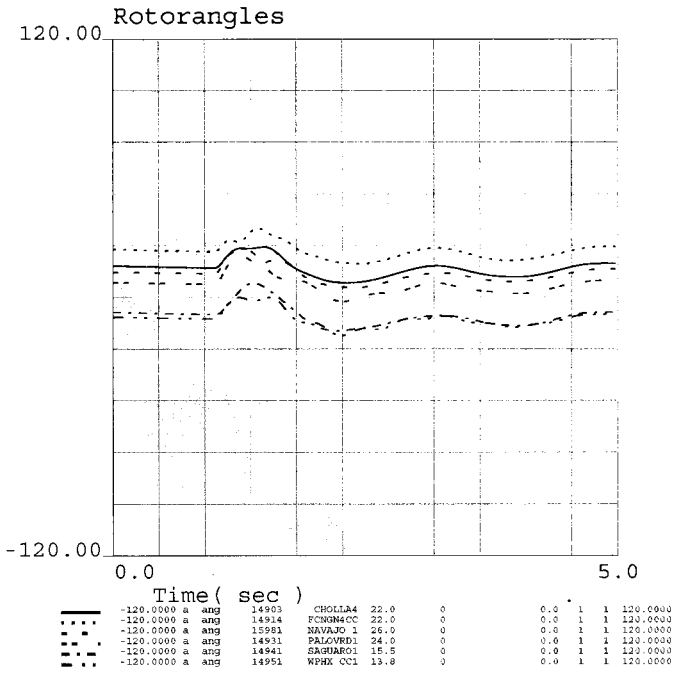

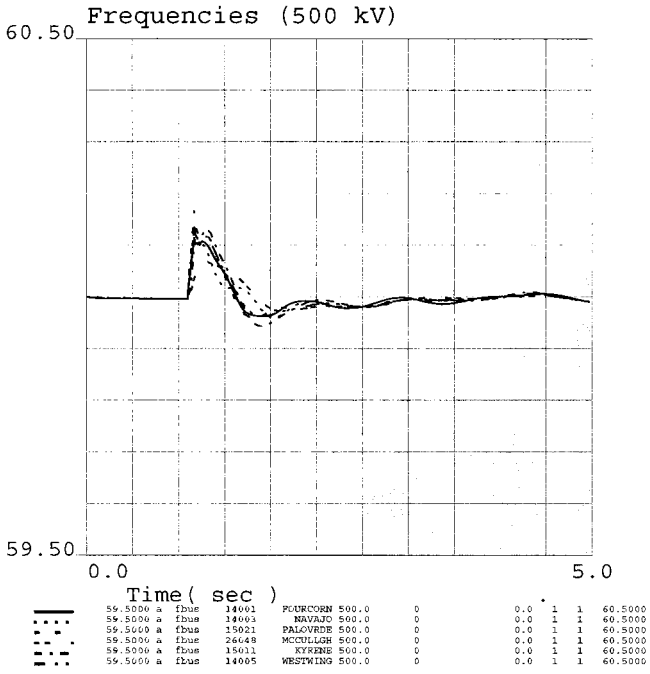

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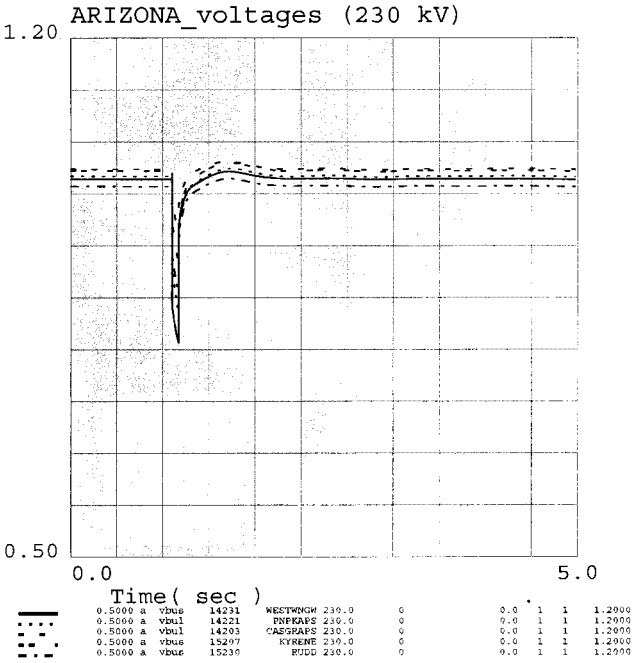

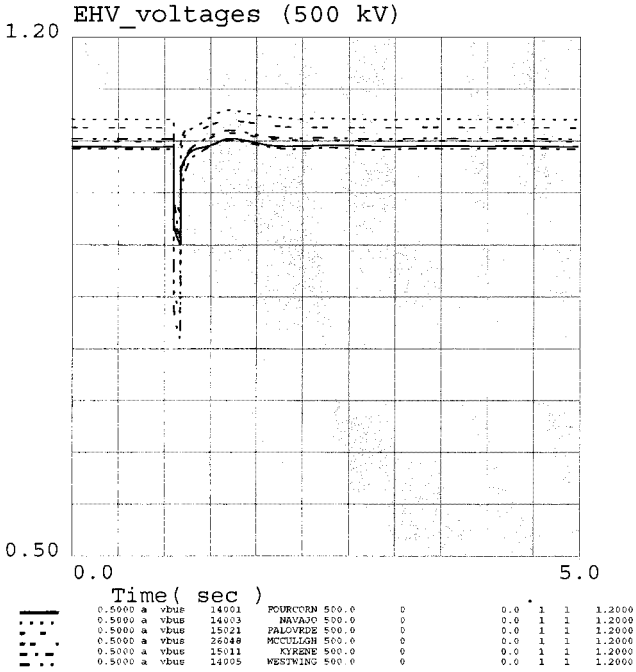

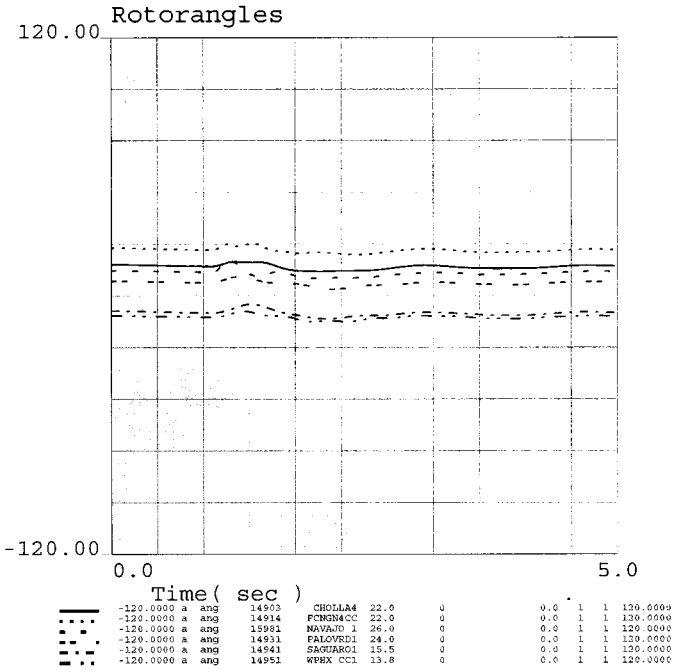

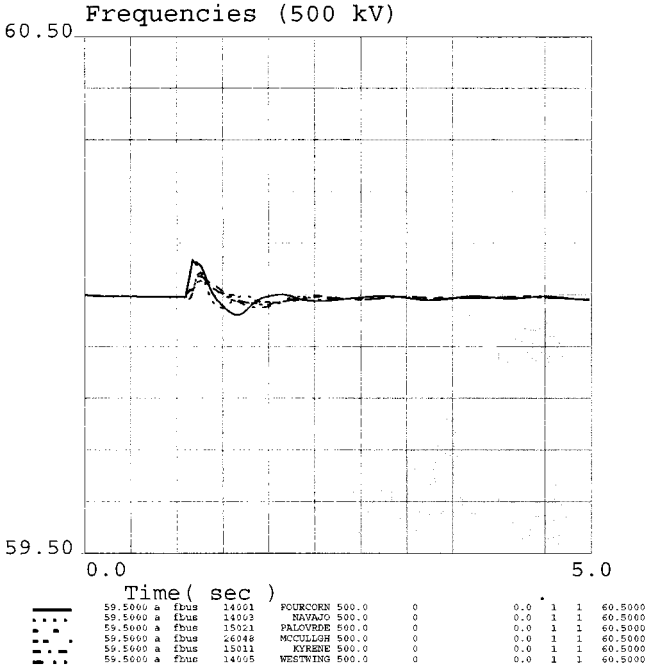

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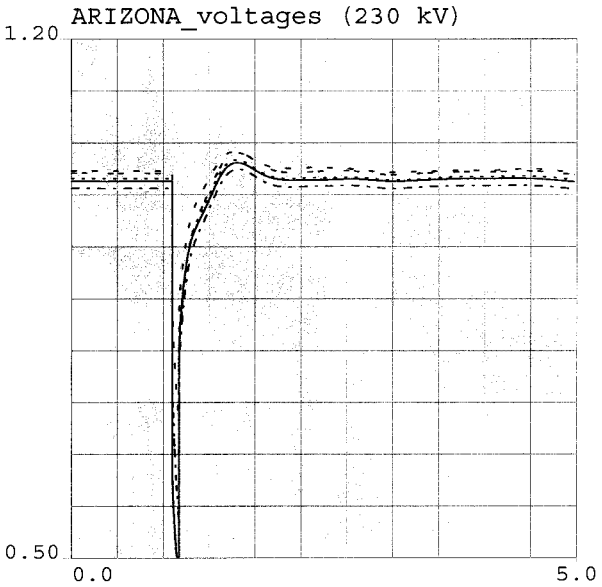
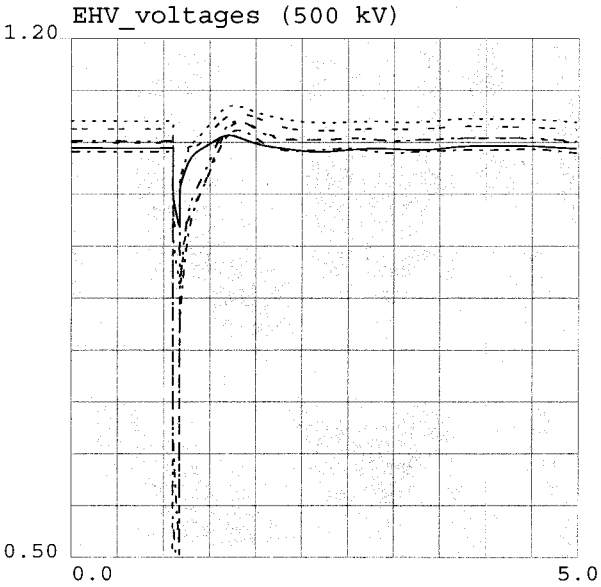
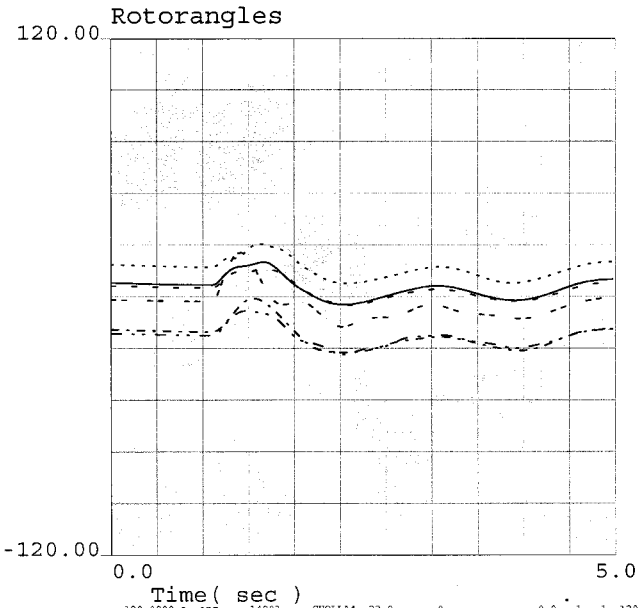


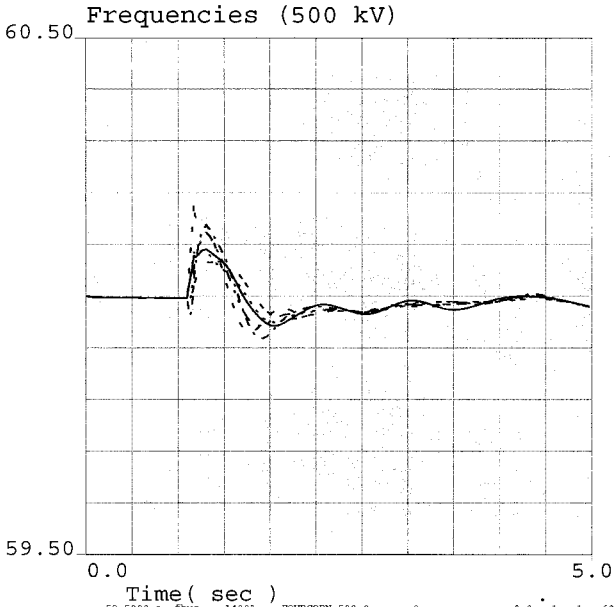
0.5000	a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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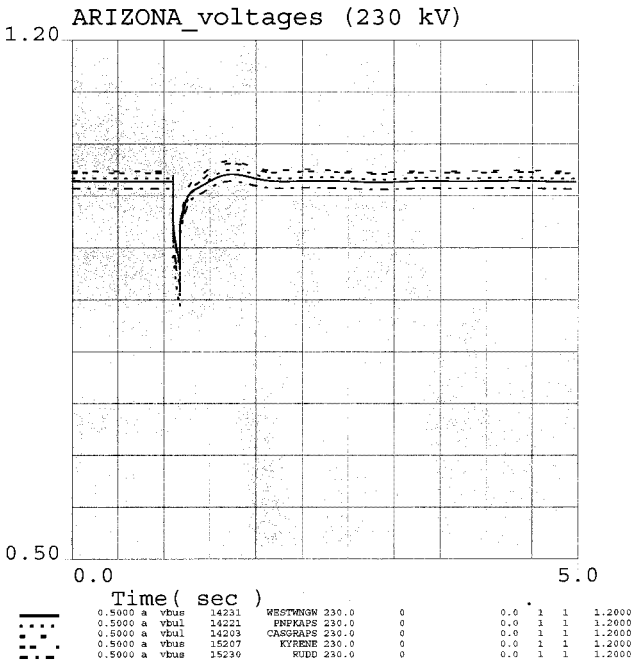

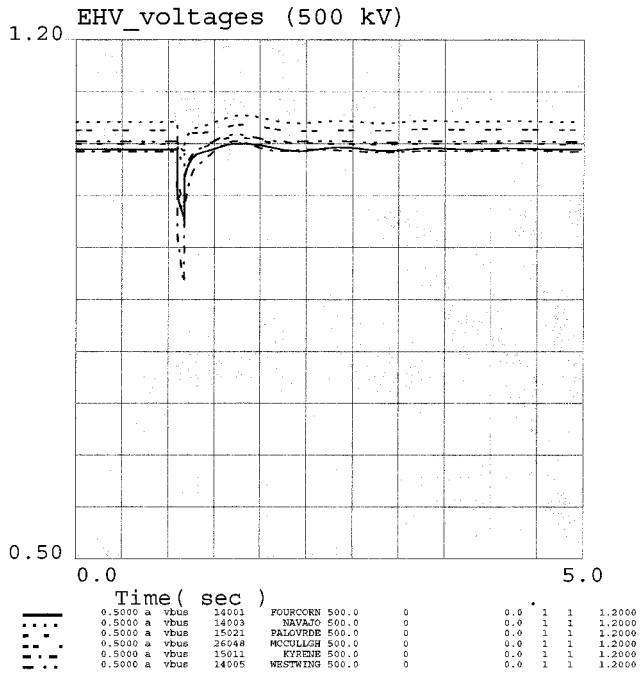

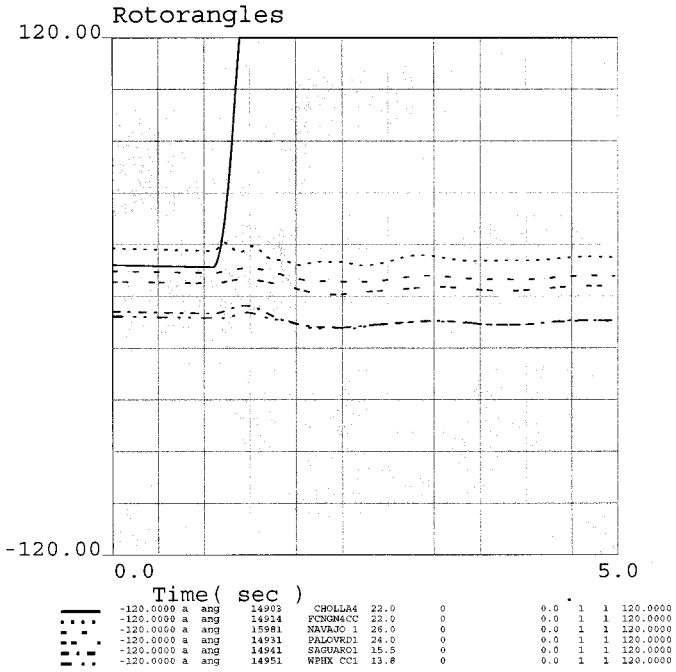

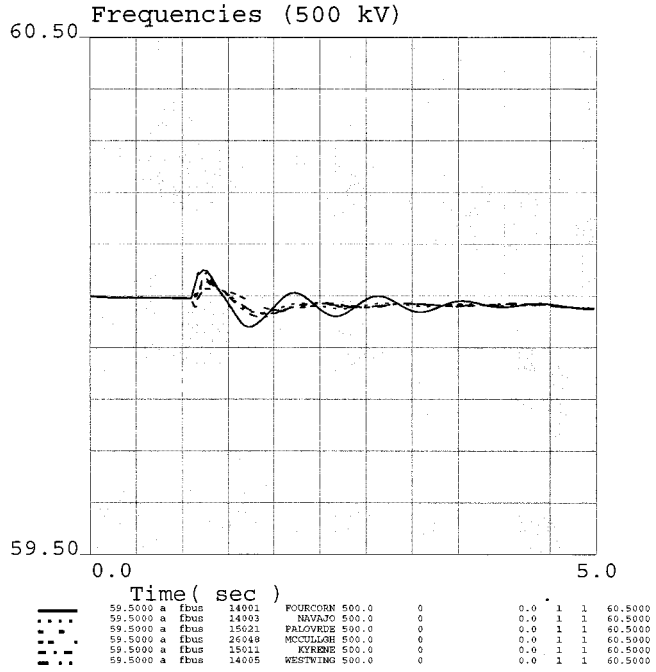

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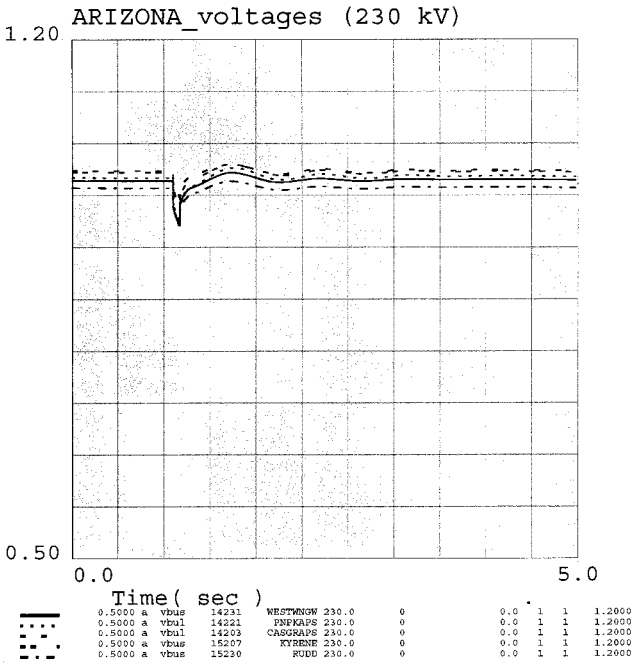

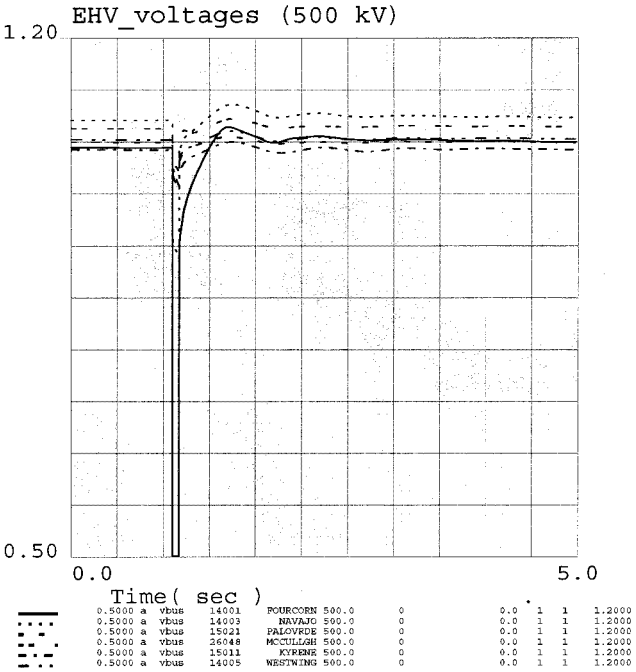

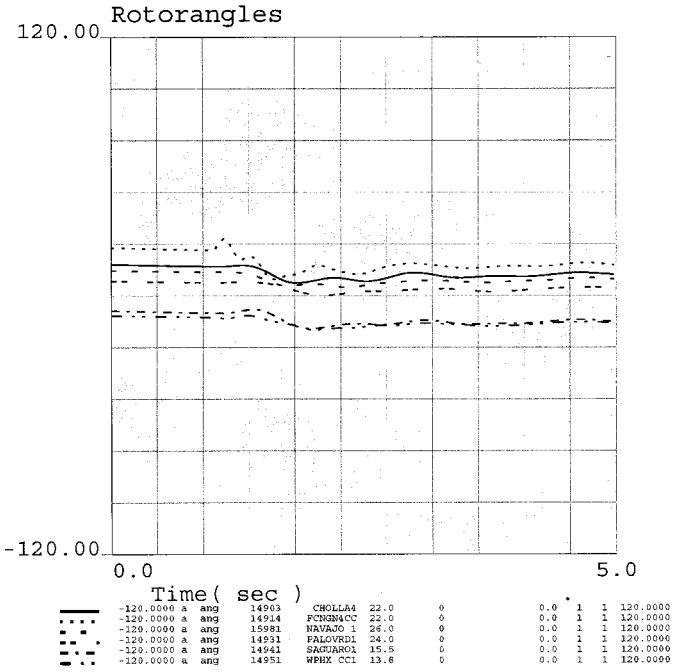

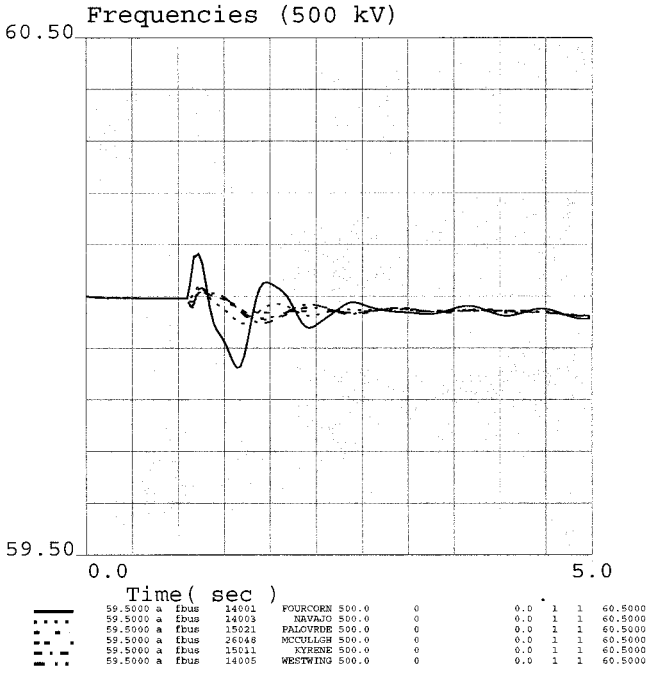

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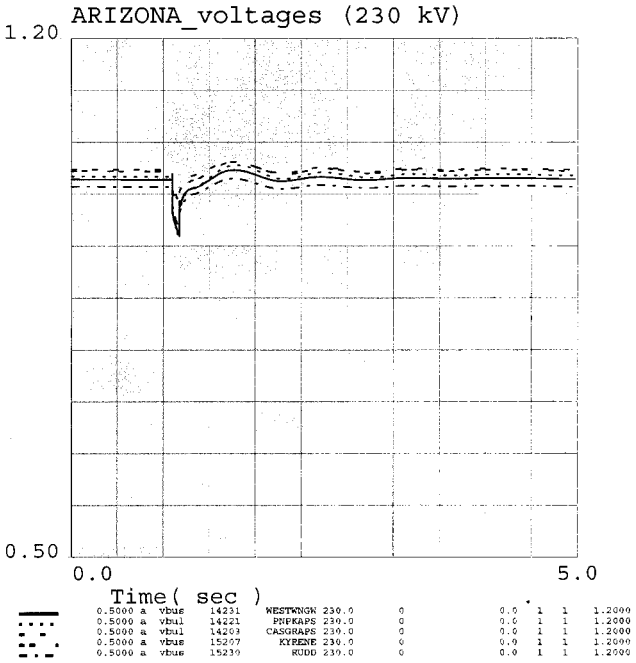

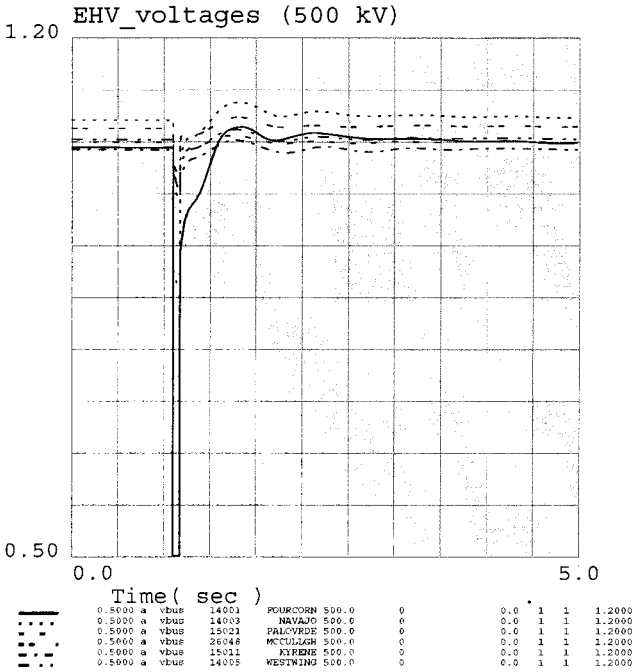

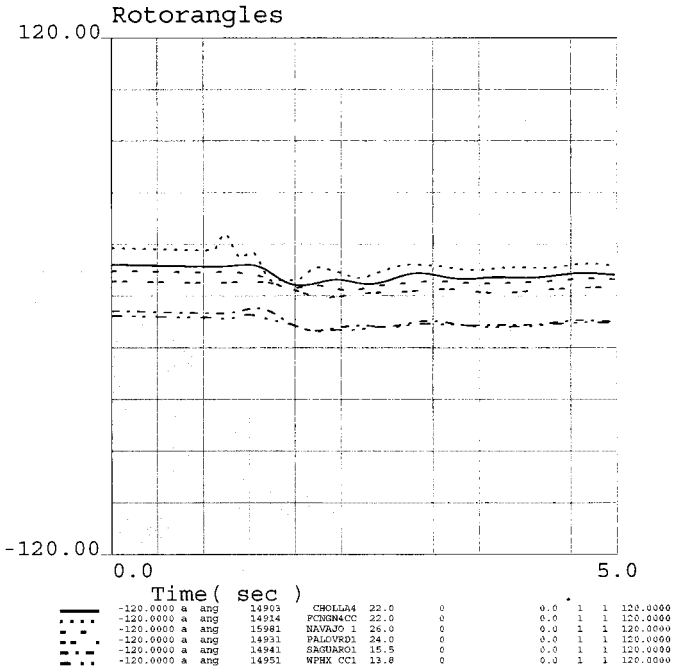

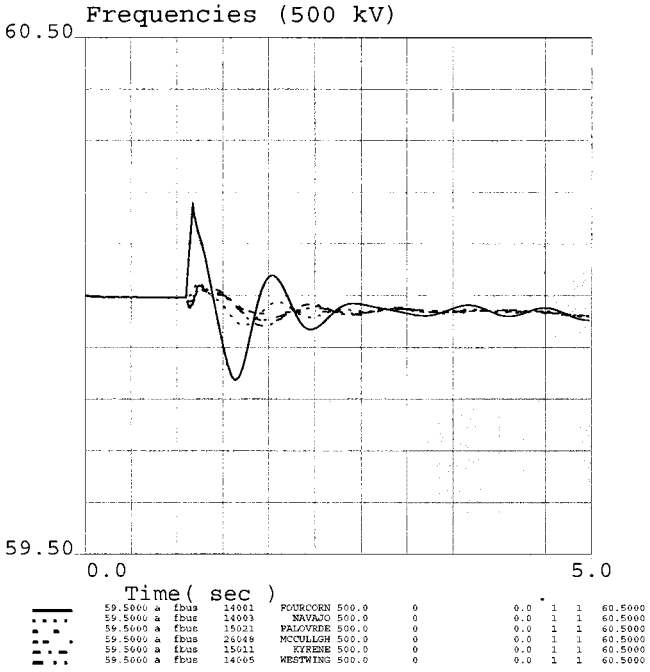

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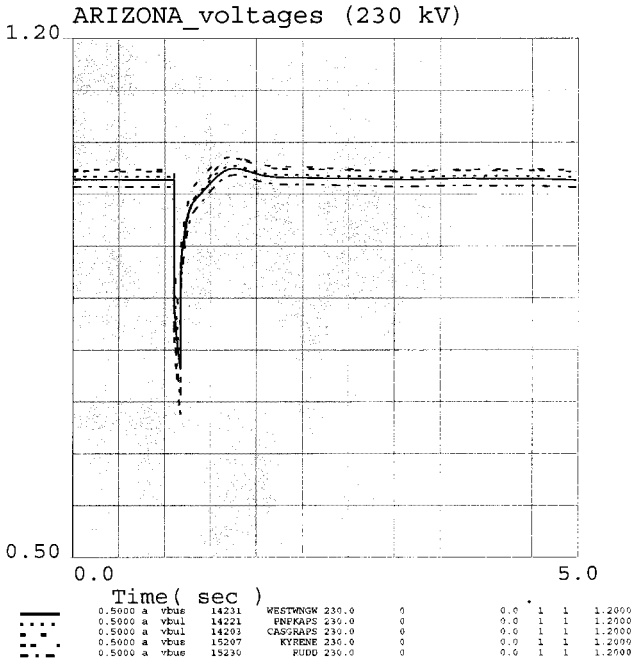

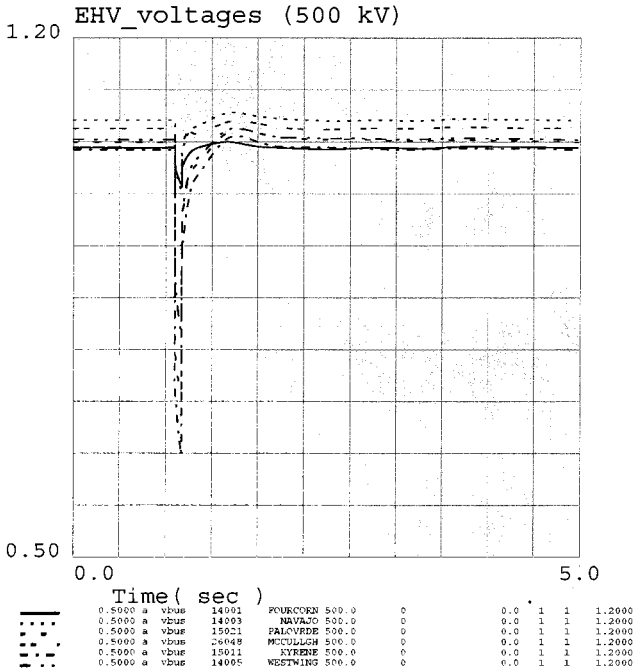

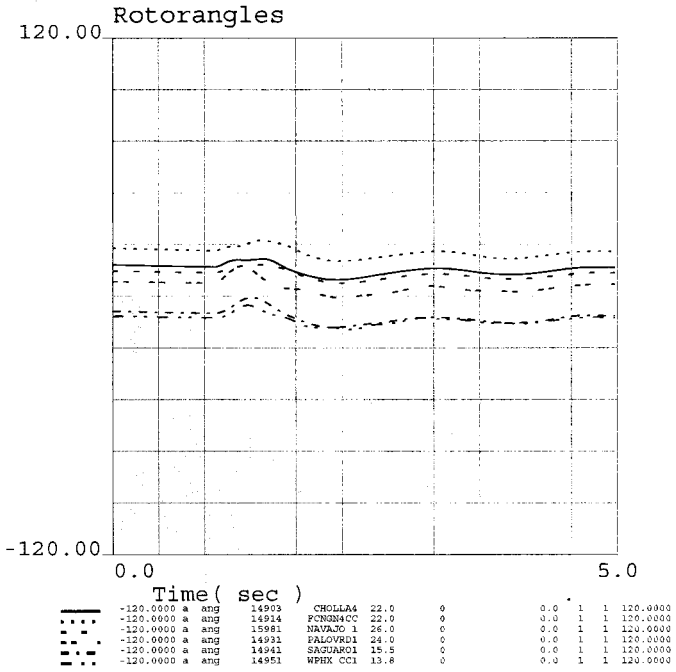

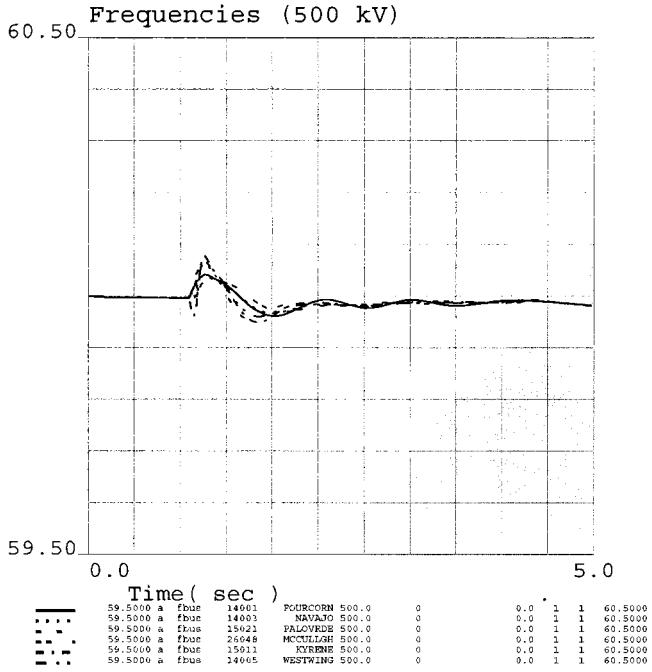

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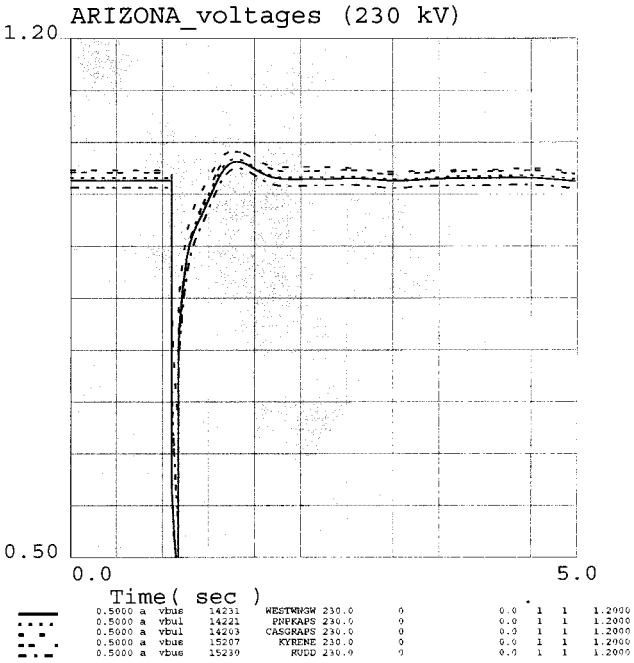

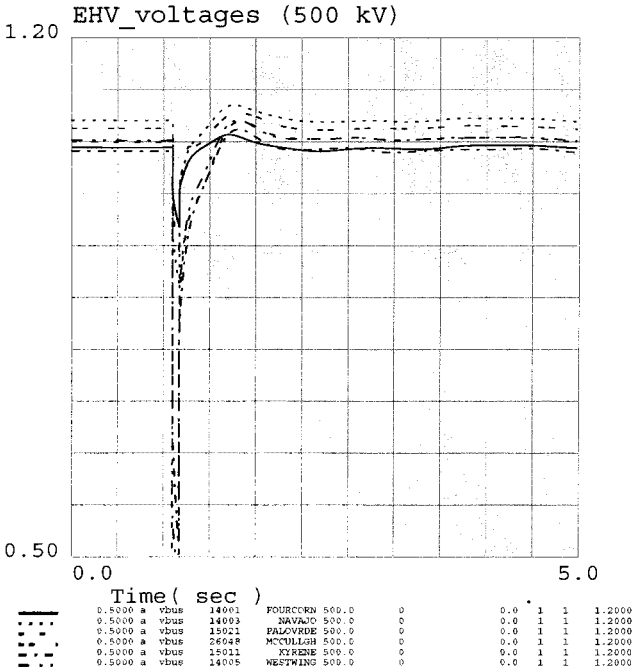

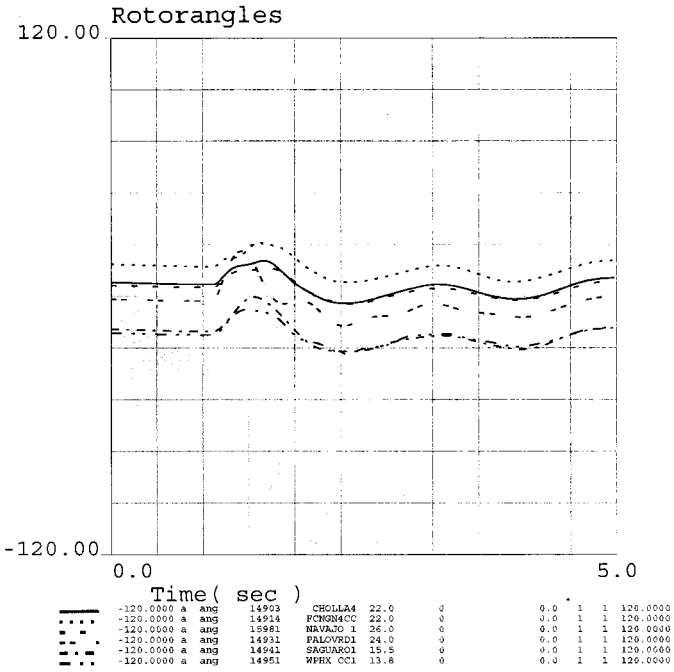

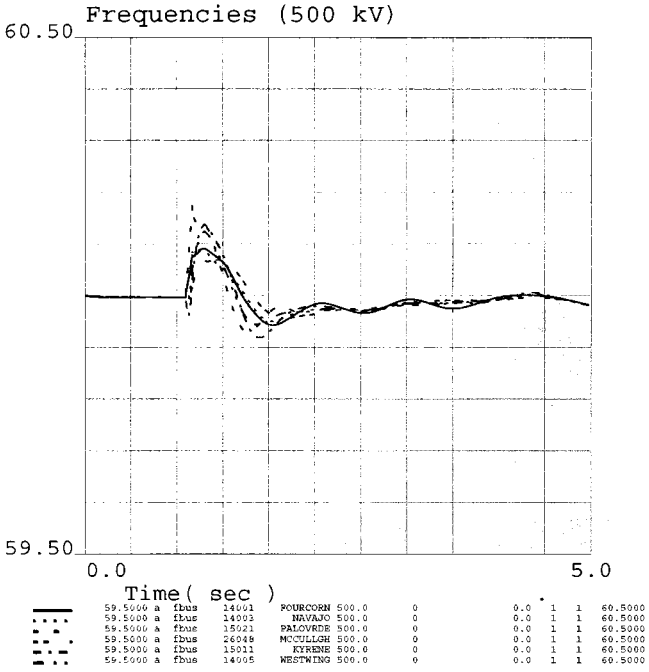

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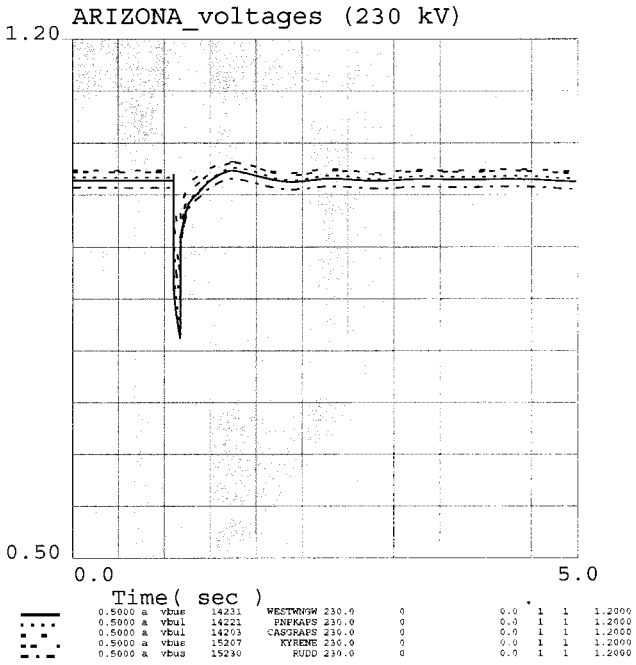

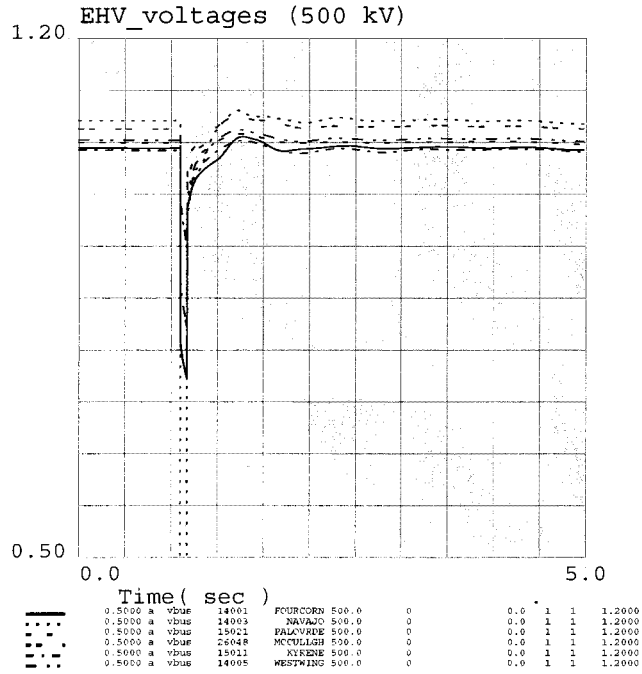

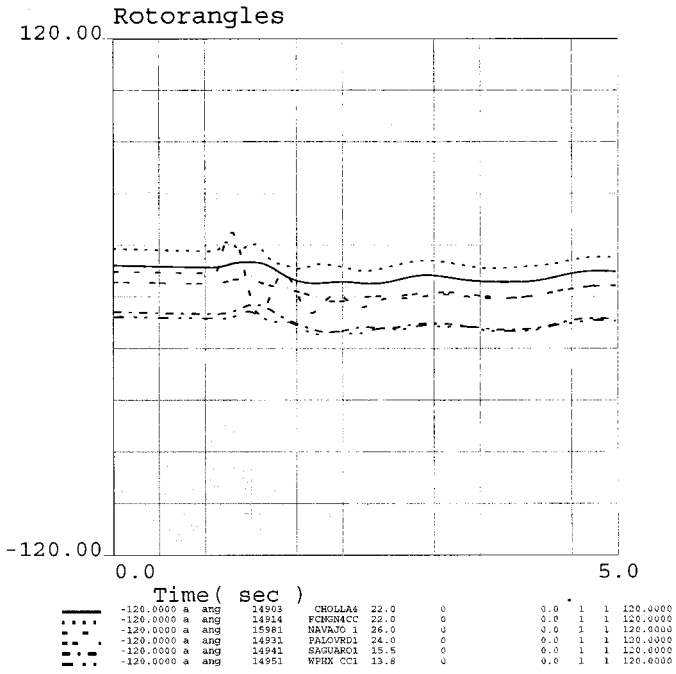

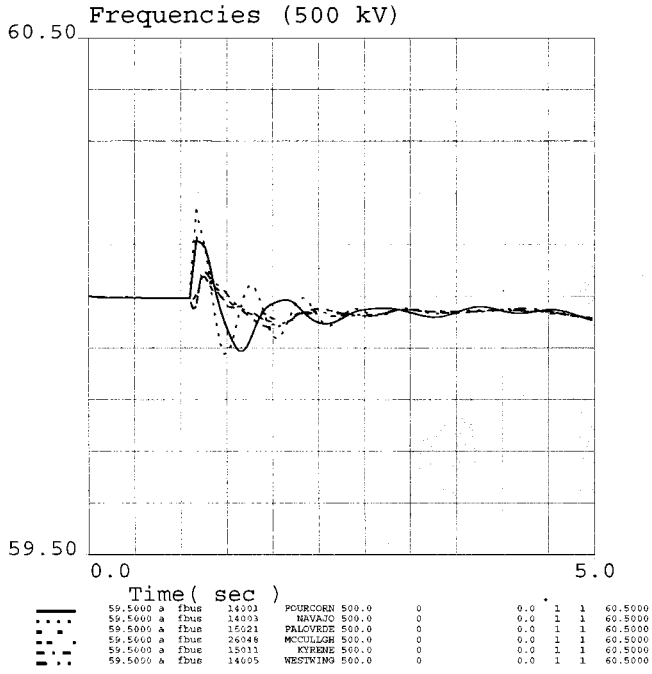

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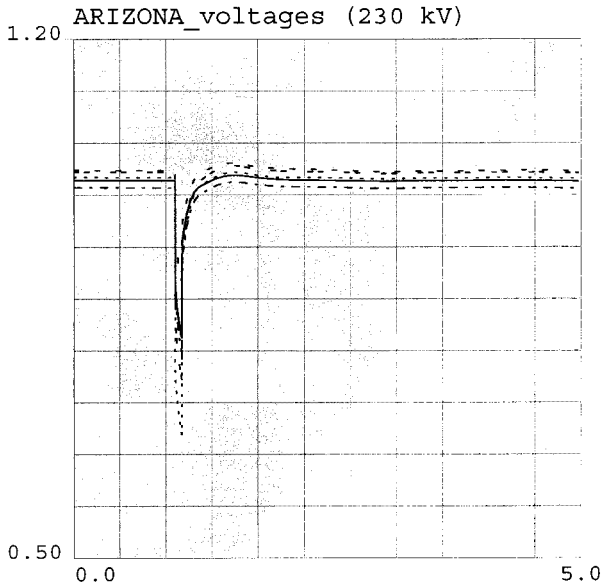
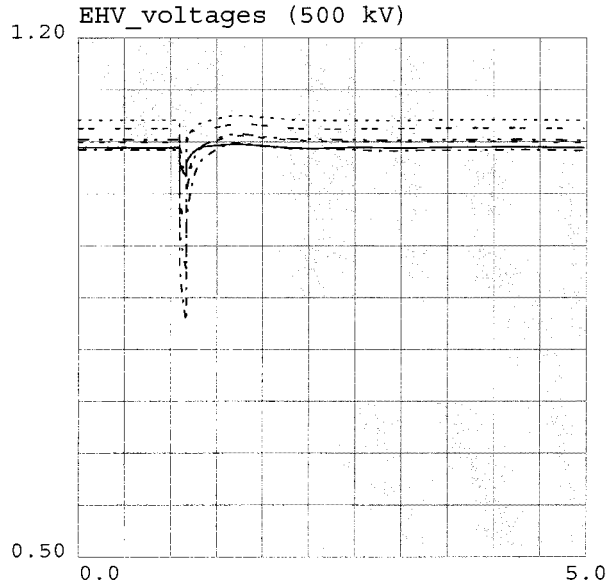
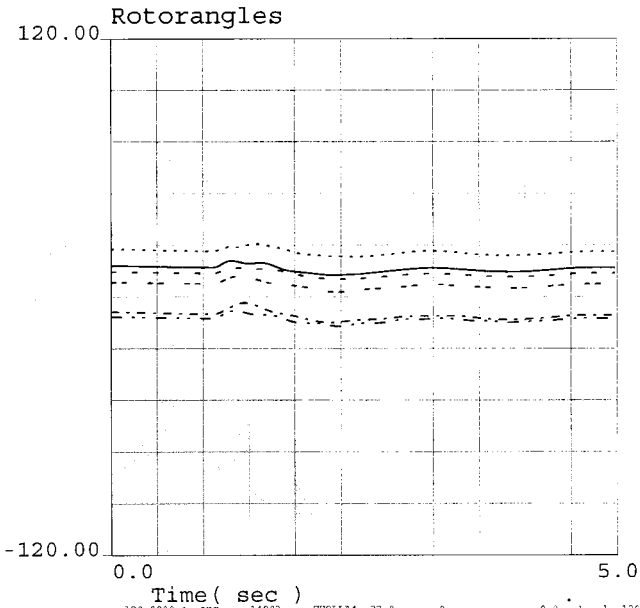


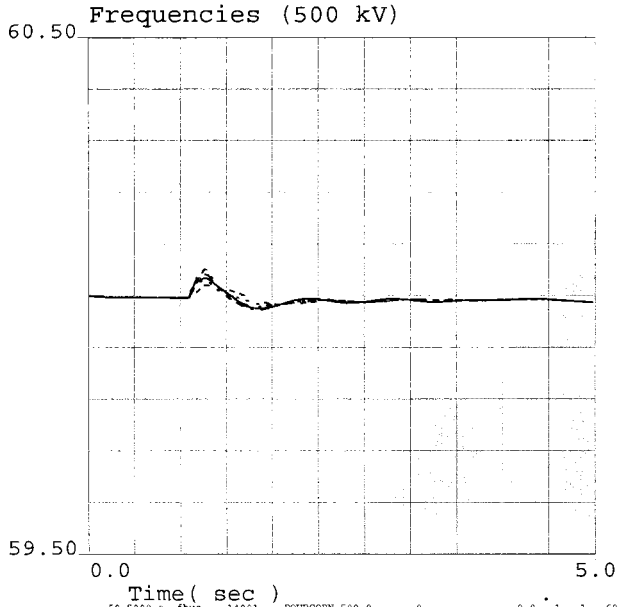
0.5000	a	vbus	14231	WESTKNGW	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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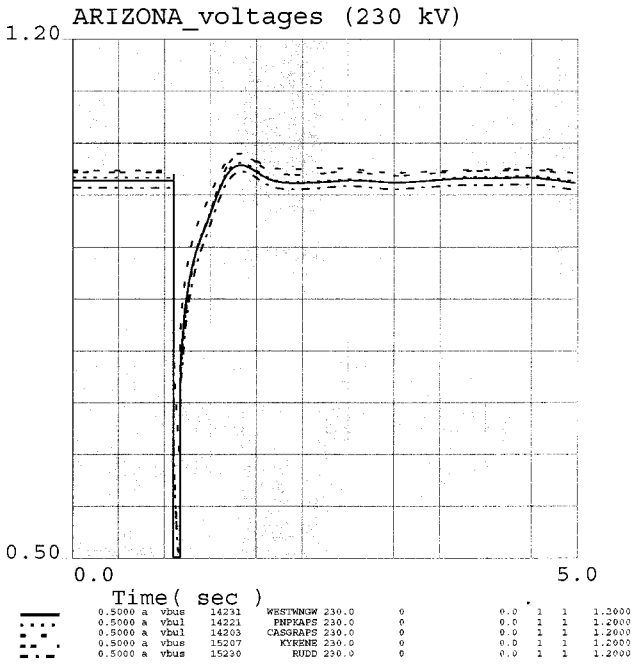

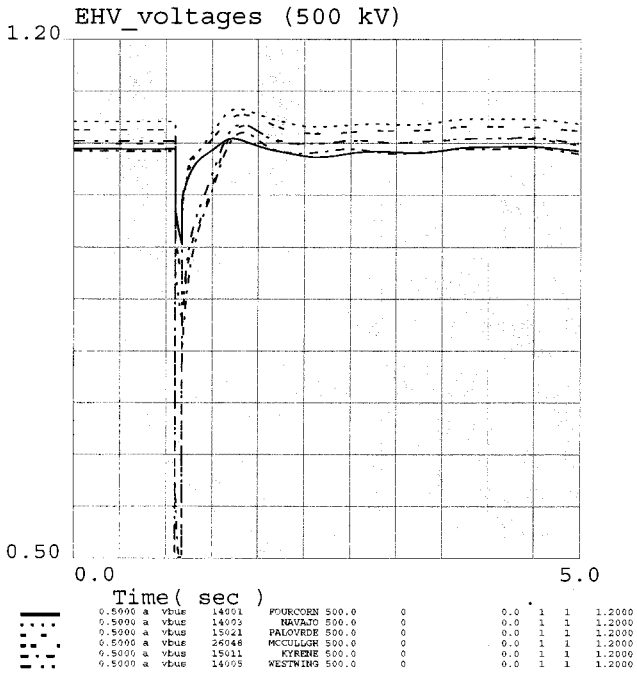

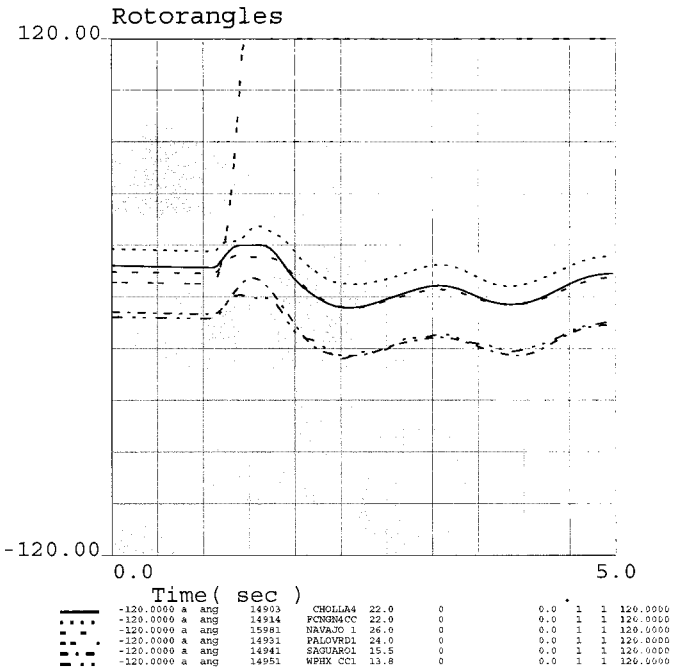

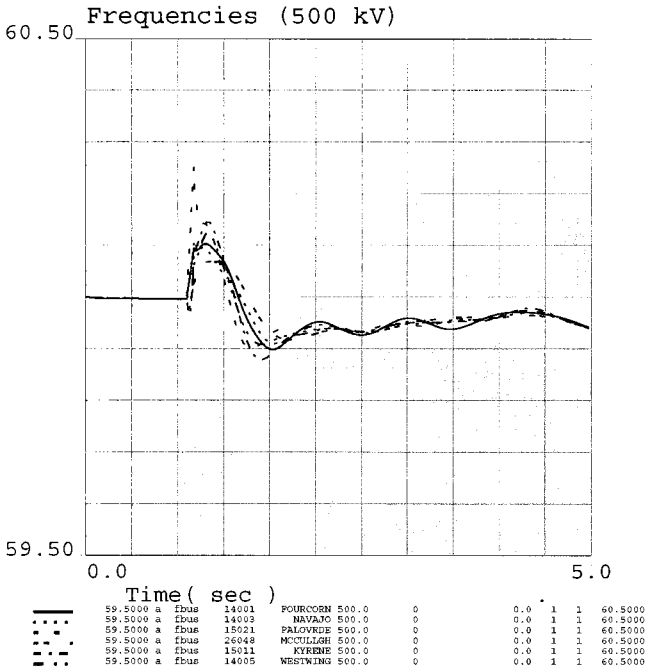

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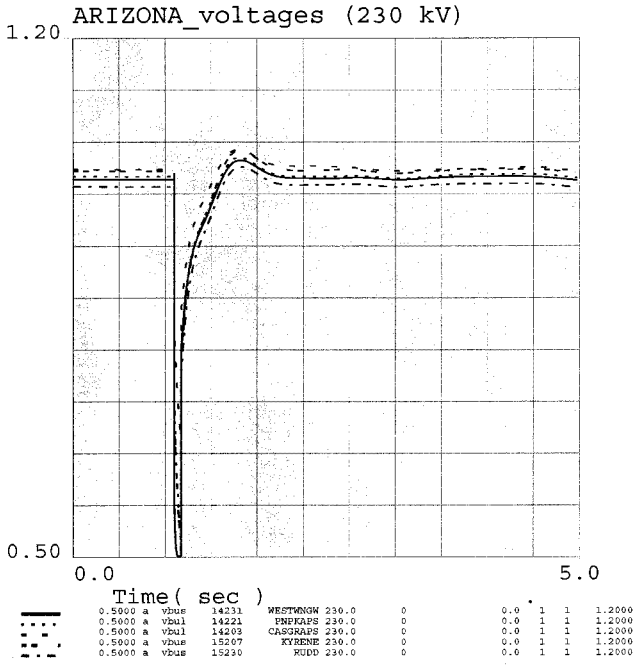

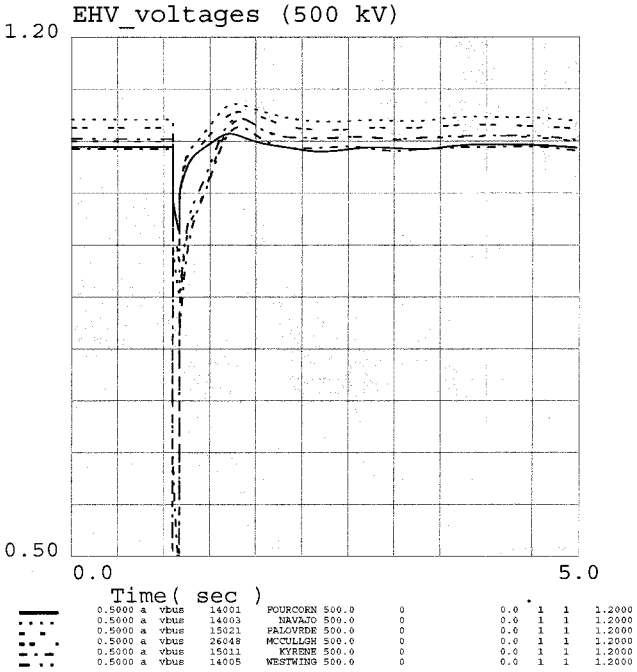

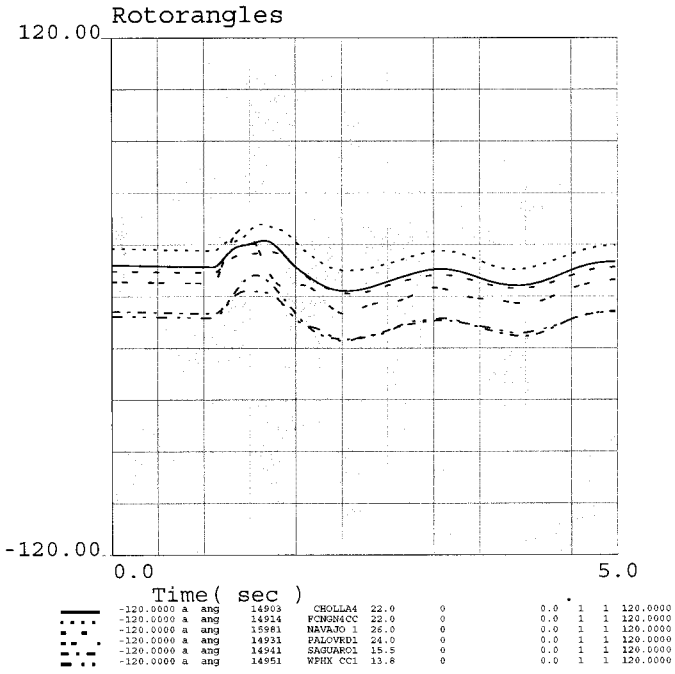

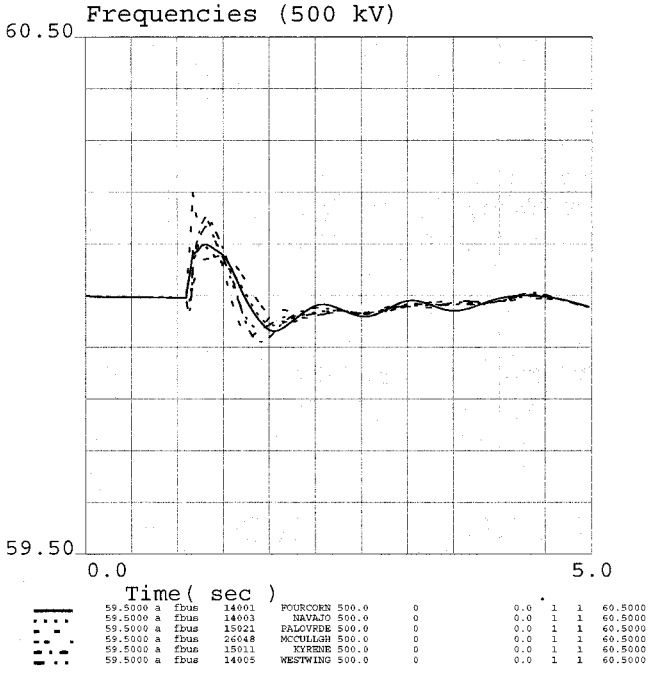

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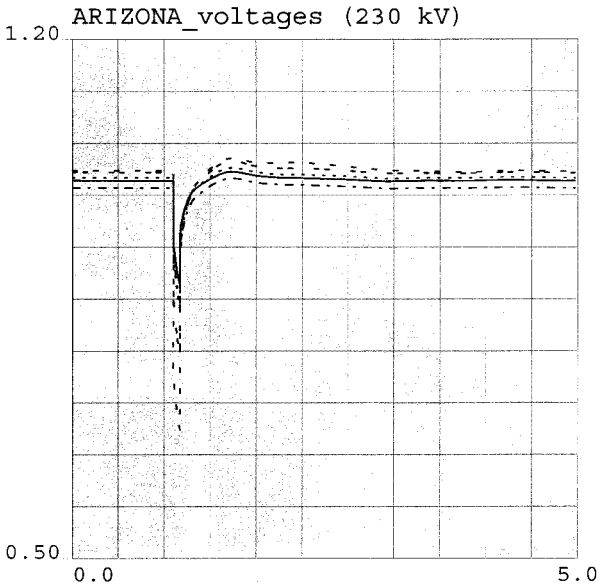

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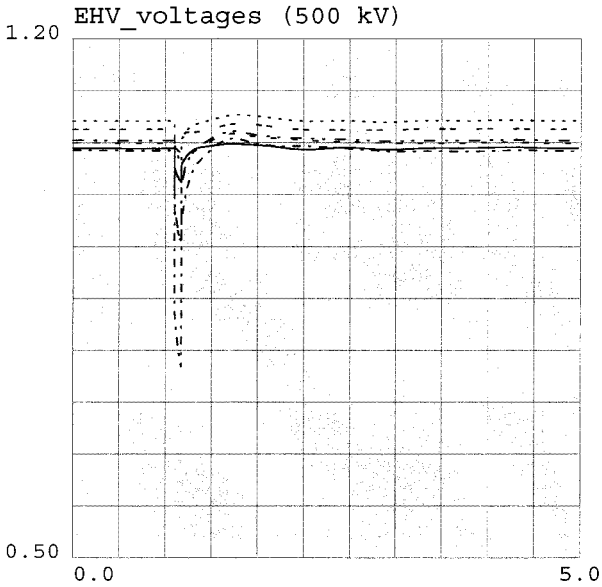
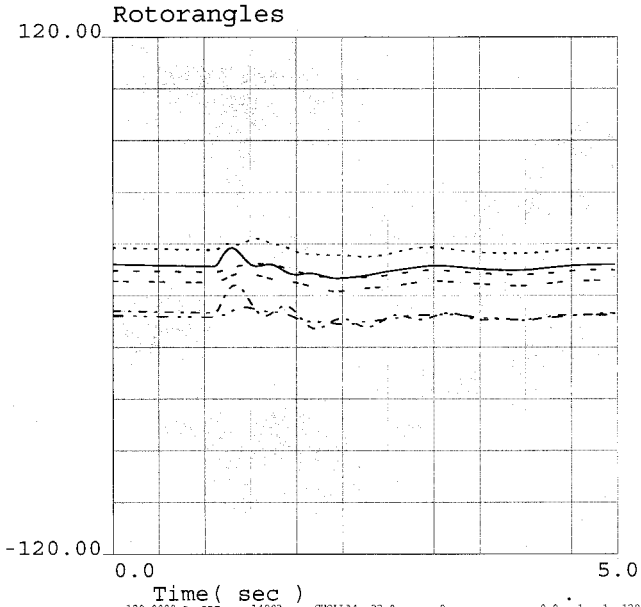
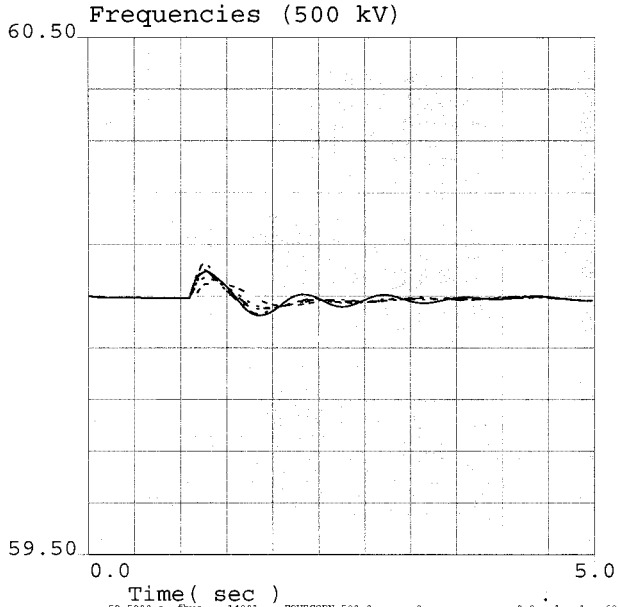
0.5000	a	vbul	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbul	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000	a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000	a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14914	PCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000	a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000	a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
-120.0000	a	ang	14951	WPHX CC1	13.8	0	0.0	1	1	120.0000



59.5000	a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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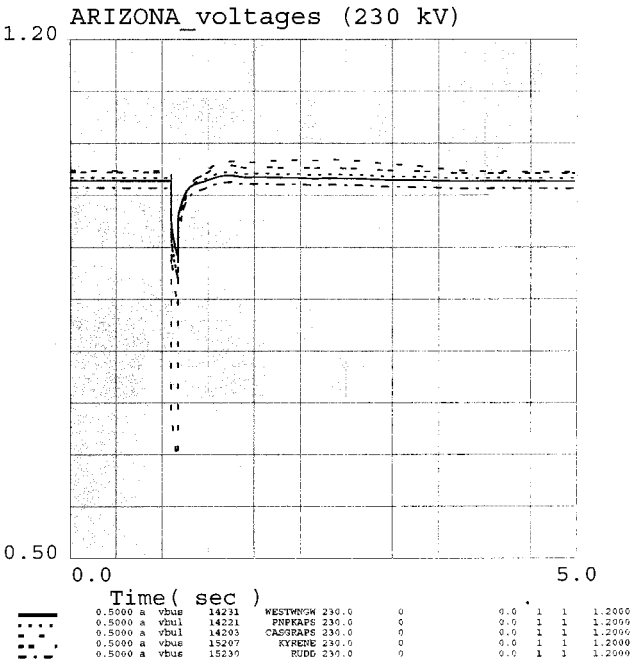

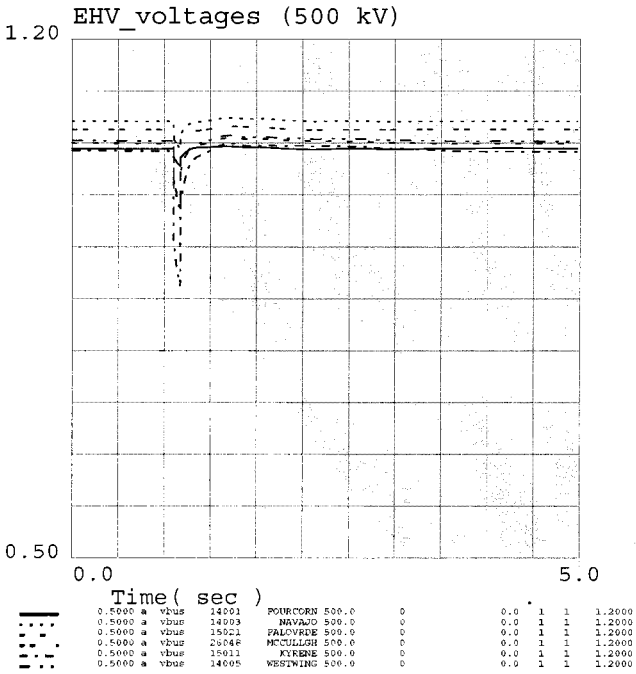

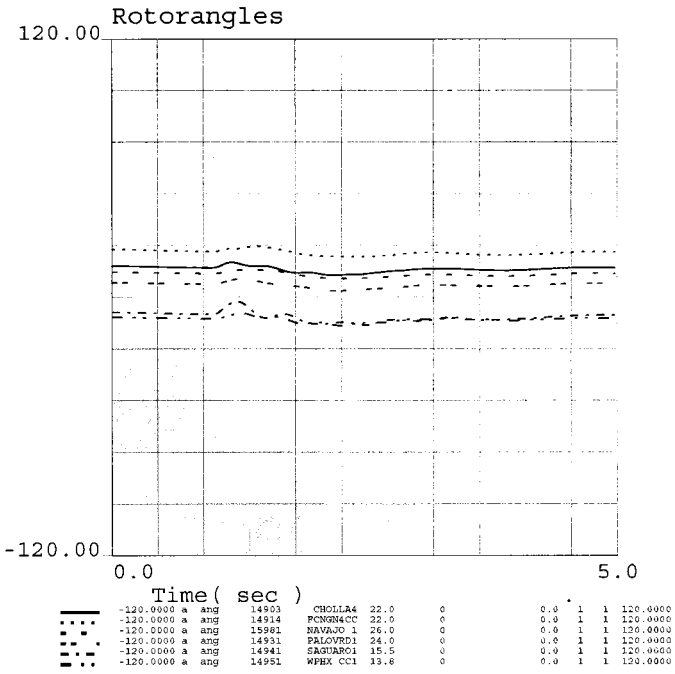

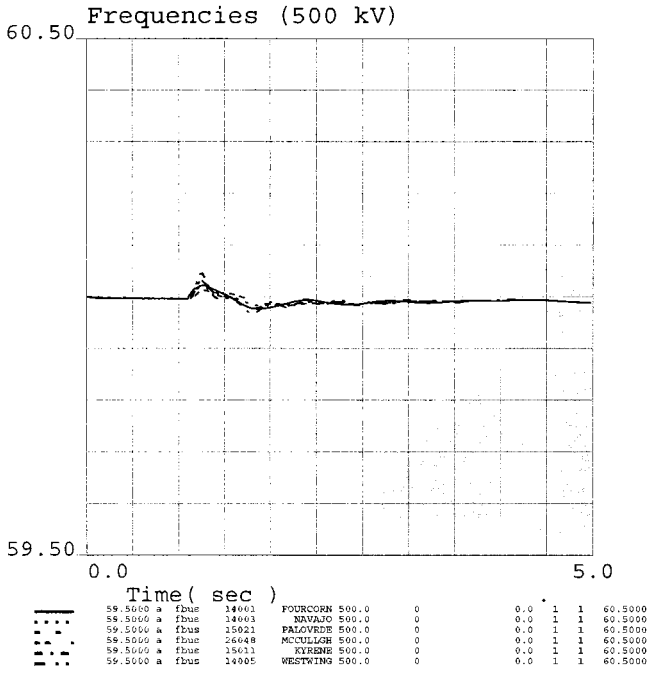

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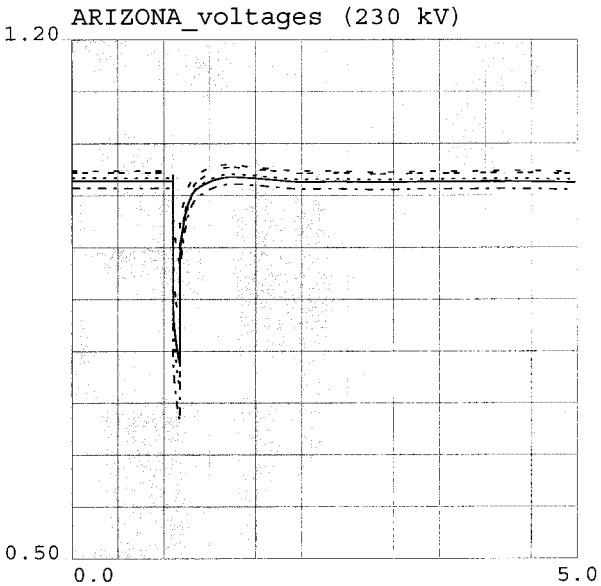

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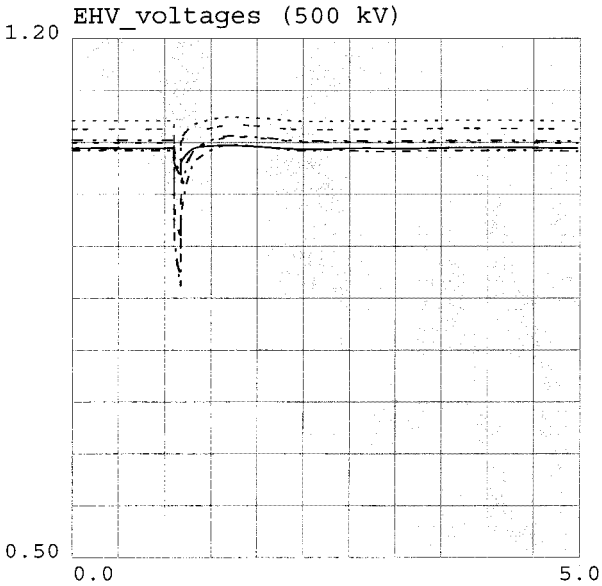
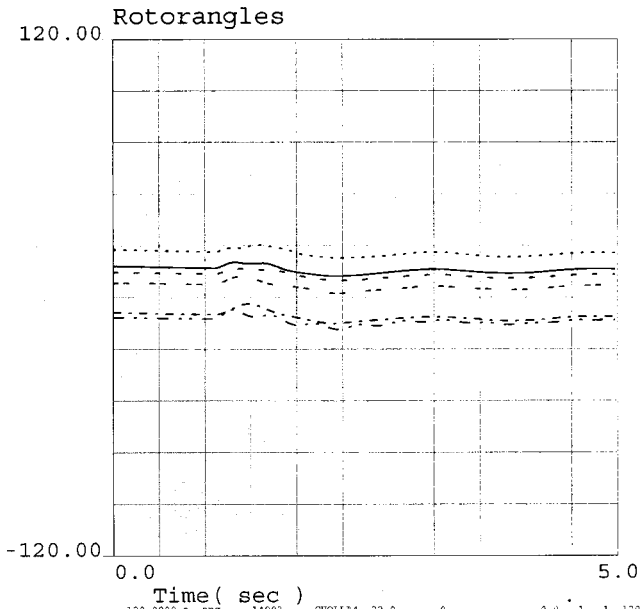
0.5000 a	vbus	14203	CASGRAFS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000 a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



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-120.0000 a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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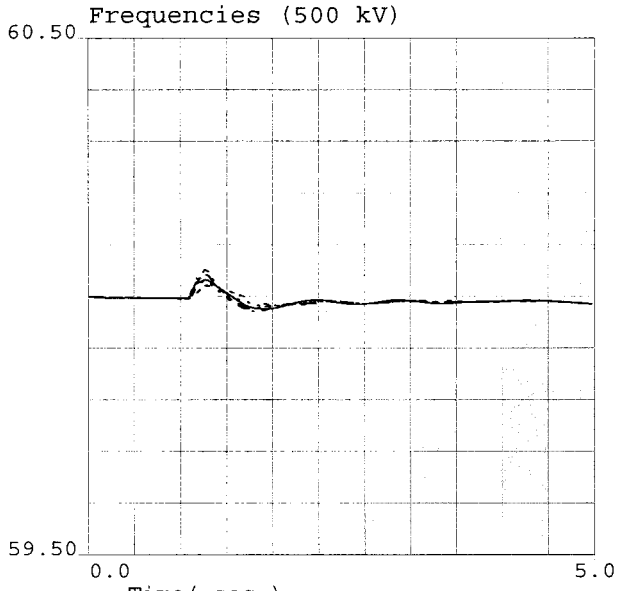

59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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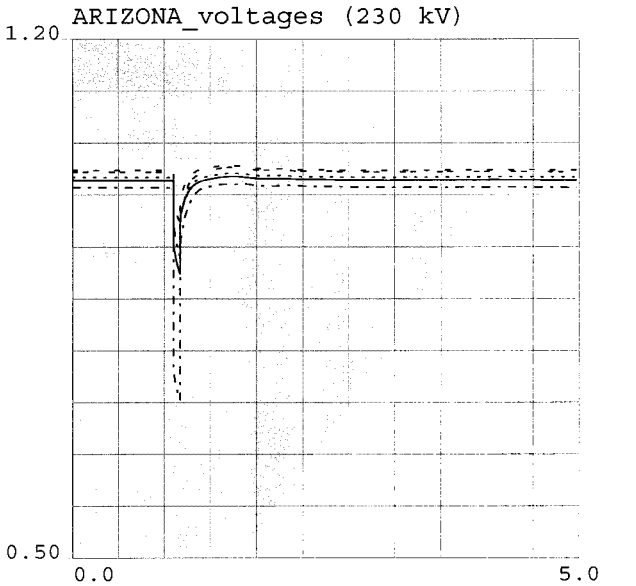
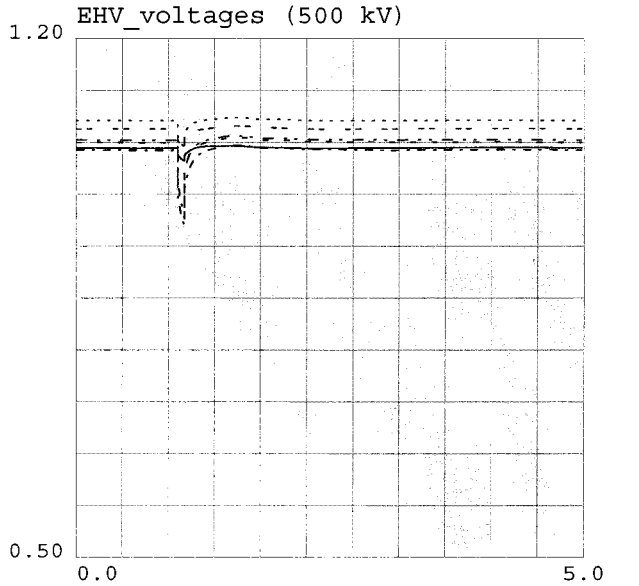
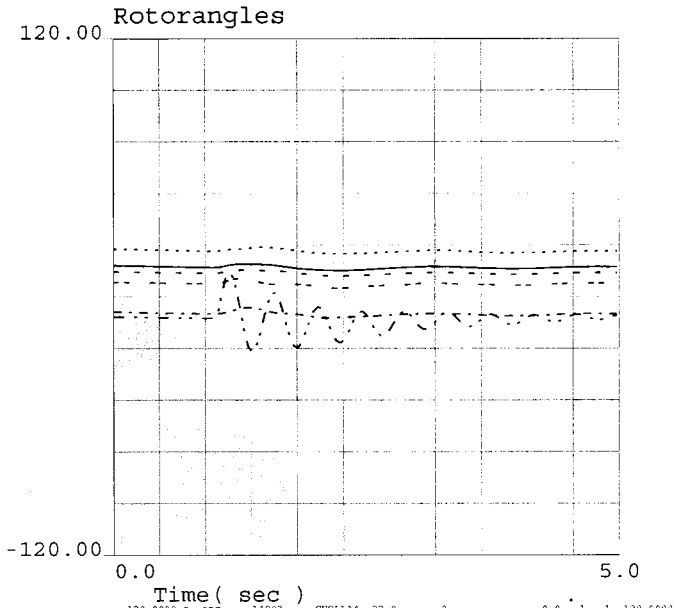


0.5000 a	vbus	14231	WESTWNGW	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14221	PNPKAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14203	CASGRAPS	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15207	KYRENE	230.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15230	RUDD	230.0	0	0.0	1	1	1.2000



0.5000 a	vbus	14001	FOURCORN	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14003	NAVAJO	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
0.5000 a	vbus	14005	WESTWING	500.0	0	0.0	1	1	1.2000



-120.0000 a	ang	14903	CHOLLA4	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14914	FCNGN4CC	22.0	0	0.0	1	1	120.0000
-120.0000 a	ang	15981	NAVAJO 1	26.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14931	PALOVRD1	24.0	0	0.0	1	1	120.0000
-120.0000 a	ang	14941	SAGUARO1	15.5	0	0.0	1	1	120.0000
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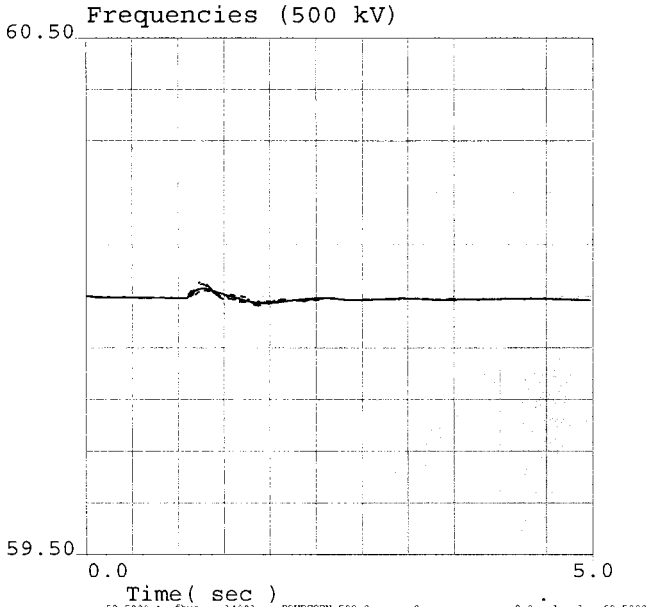

59.5000 a	fbus	14001	FOURCORN	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14003	NAVAJO	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
59.5000 a	fbus	14005	WESTWING	500.0	0	0.0	1	1	60.5000

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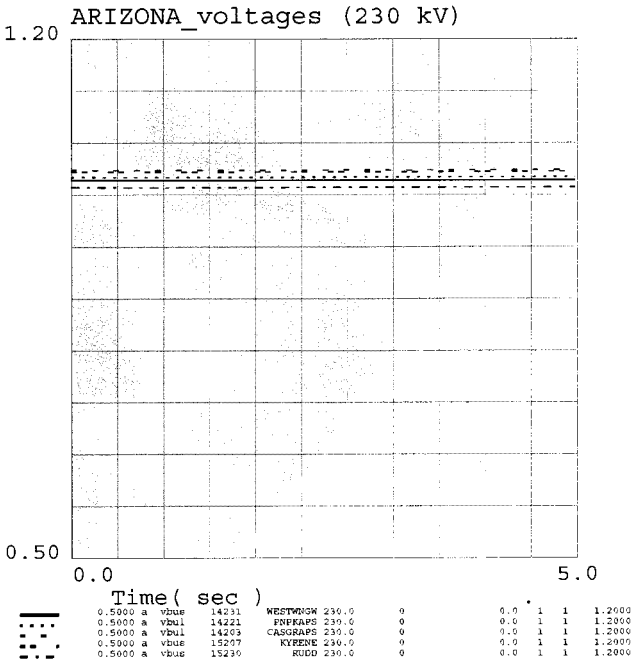

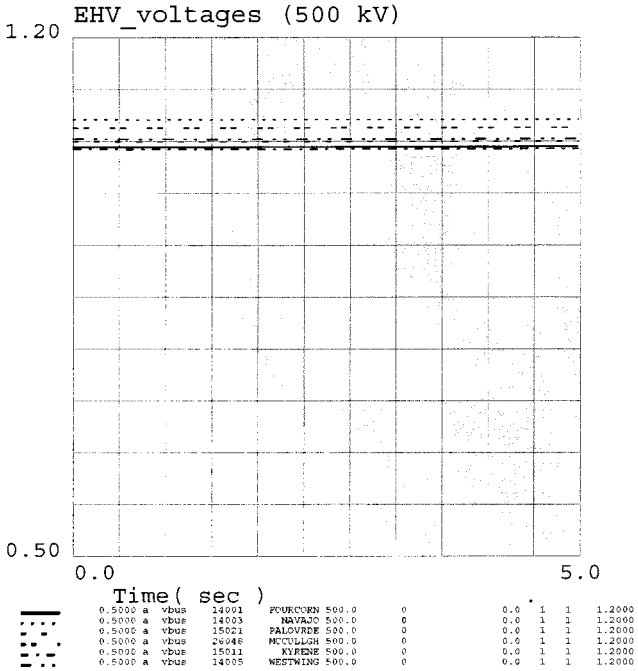

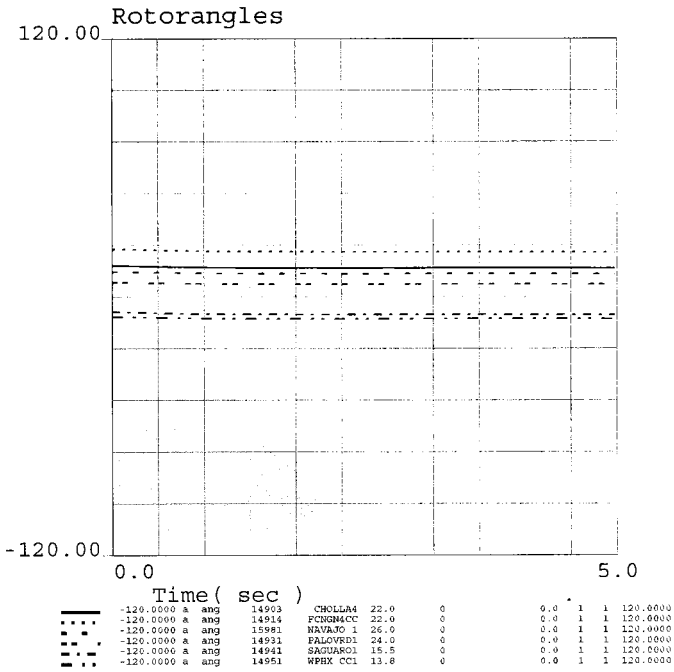

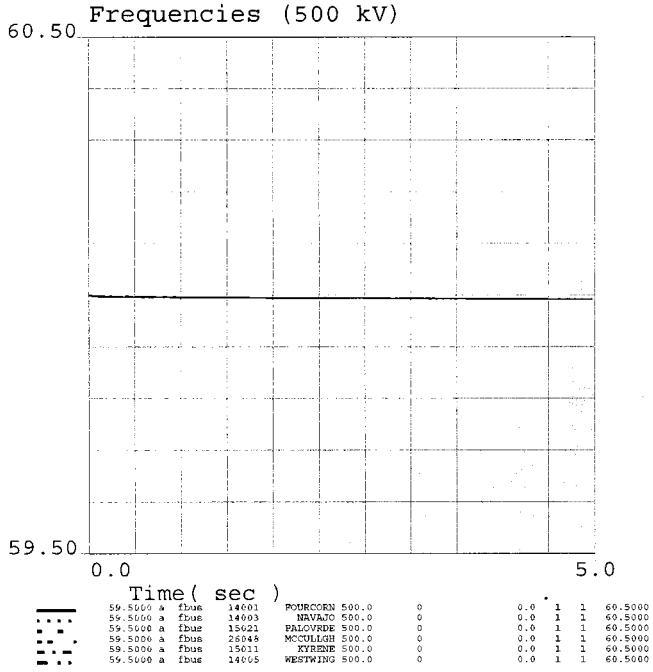

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APPENDIX D

2018
Stability Plots

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Transmission Element Outages			
From Bus (Fault Location)	To Bus	kV	
Avery	Raceway	230	1
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Cholla	LEUPP	230	10
Cholla	Preacher Canyon	345	11
Cholla	Pinnacle Peak	345	12
Cholla	Saguaro	500	13
Cholla	Sugar Loaf	500	14
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Coronado	Sugar Loaf	500	16
Delany	Harquhala	500	17
Delany	Hassayampa	500	18
Delany	Sun Valley	500	19
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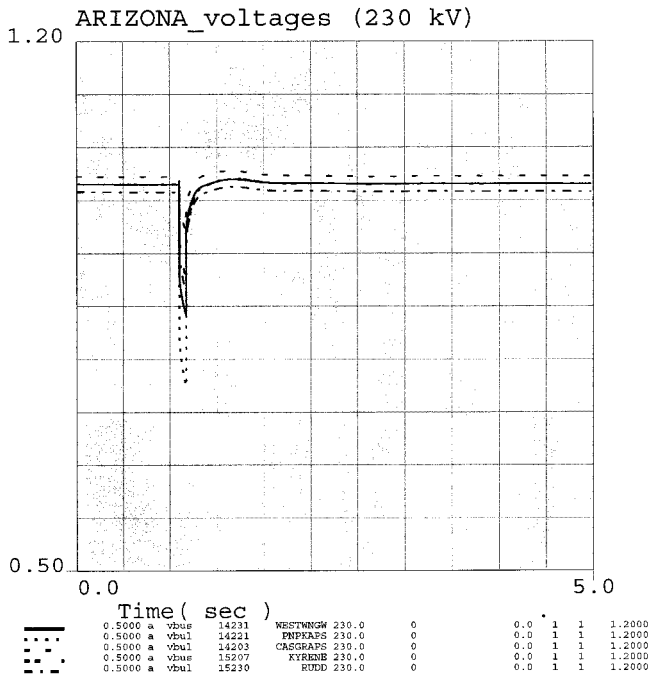

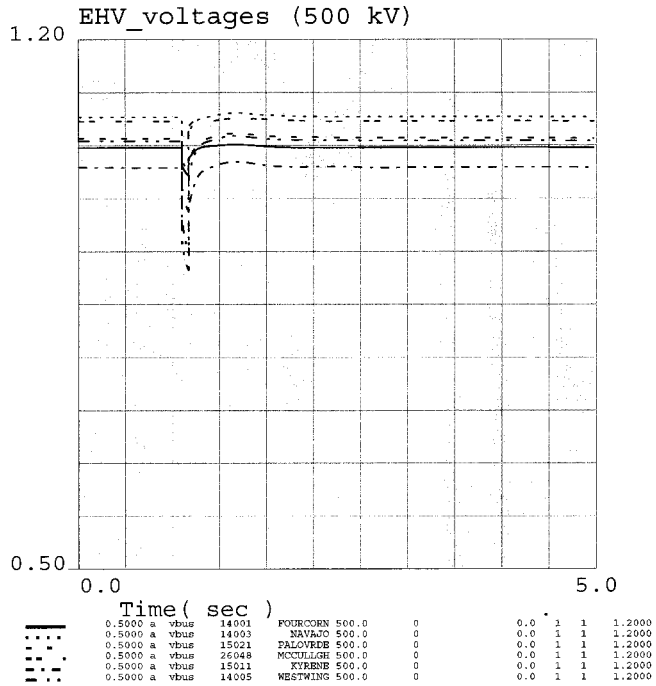

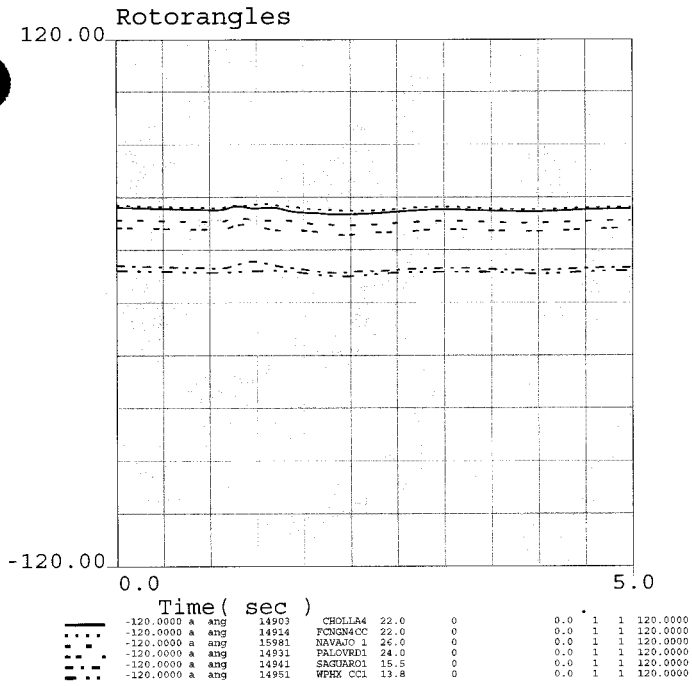

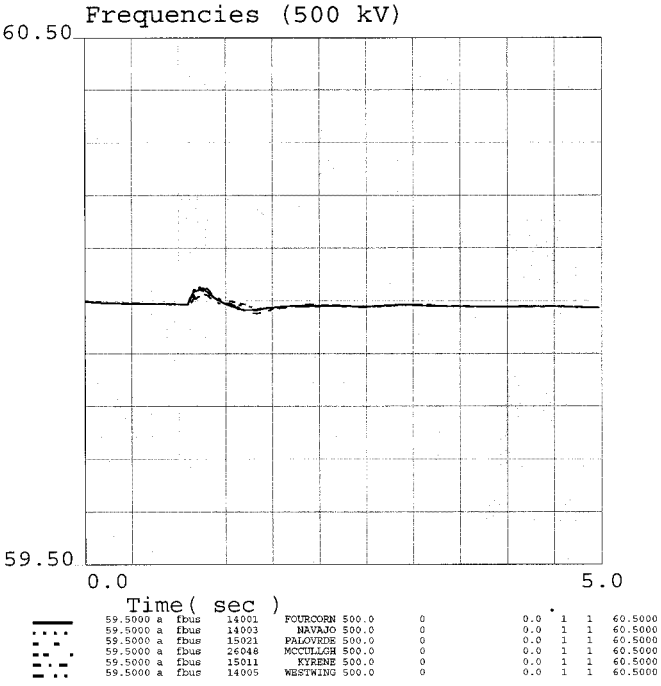

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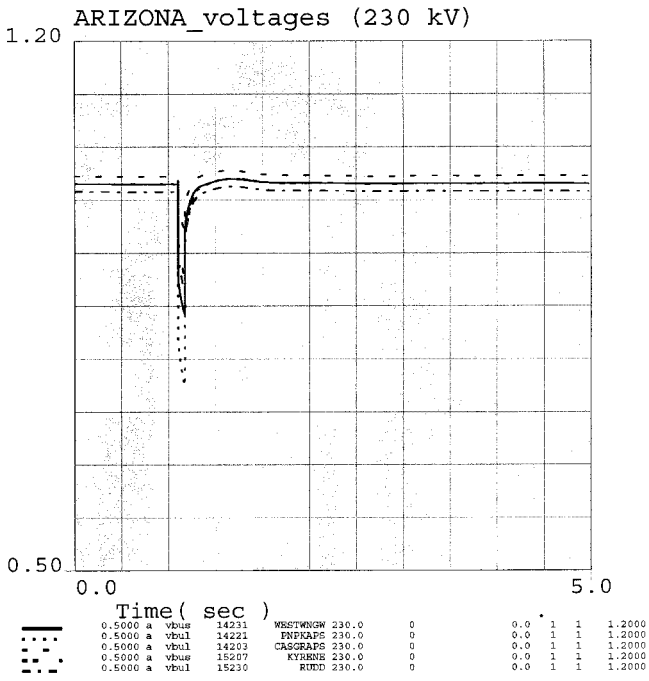

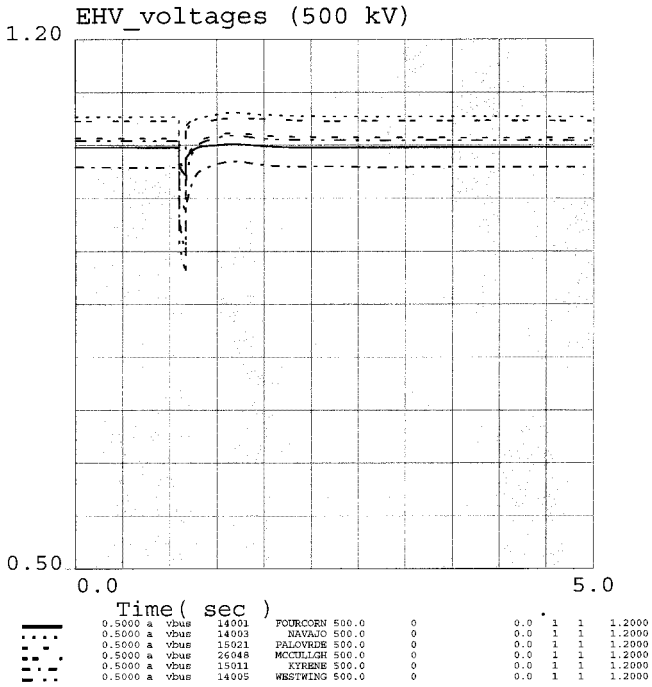

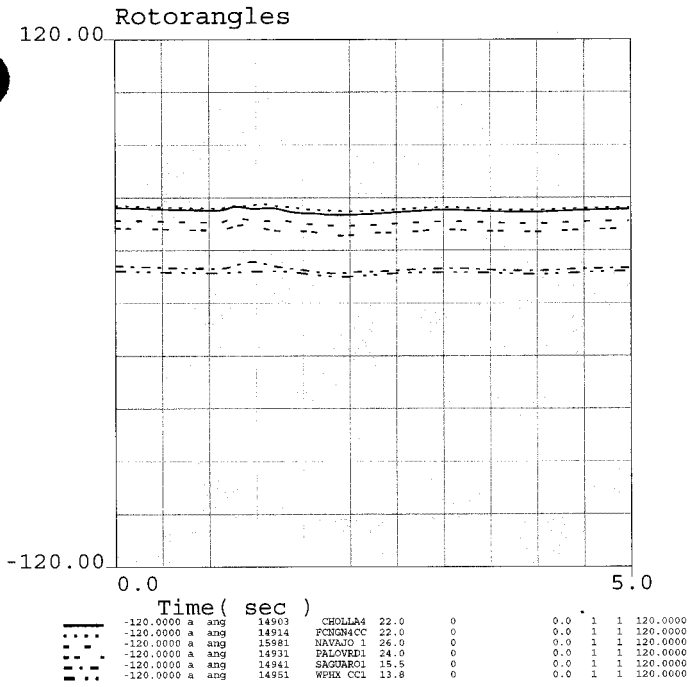

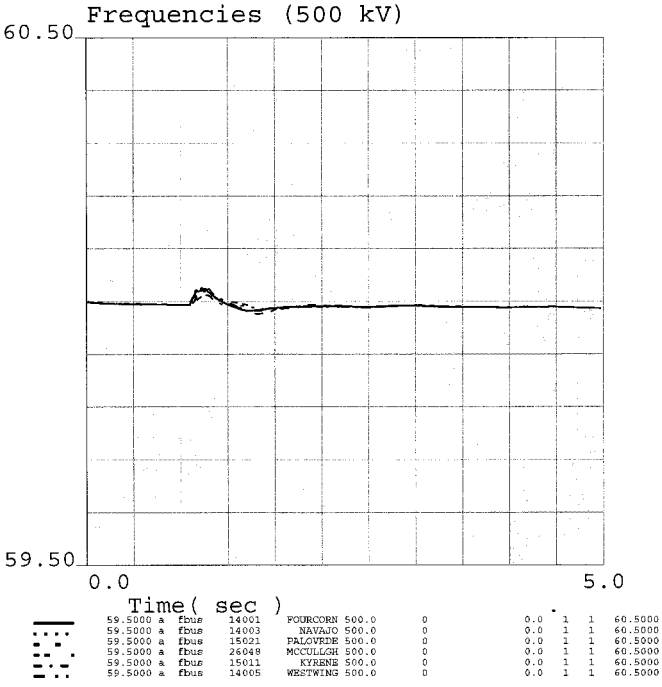

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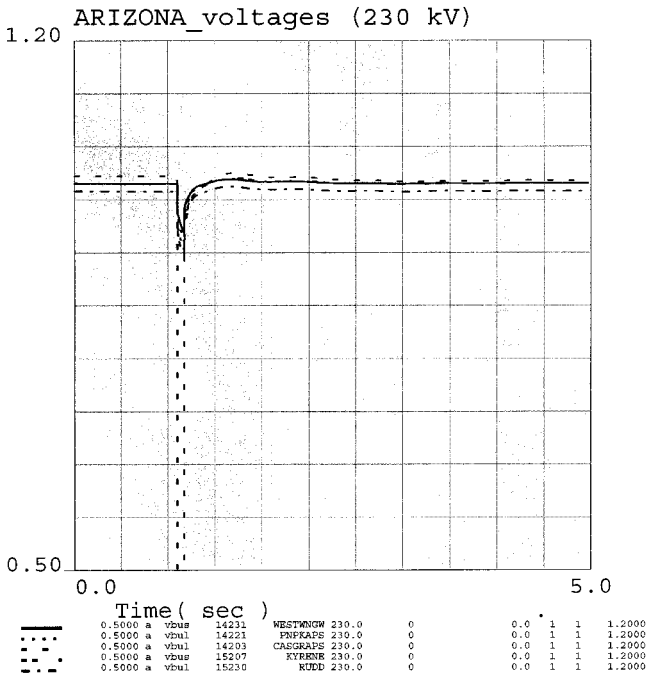

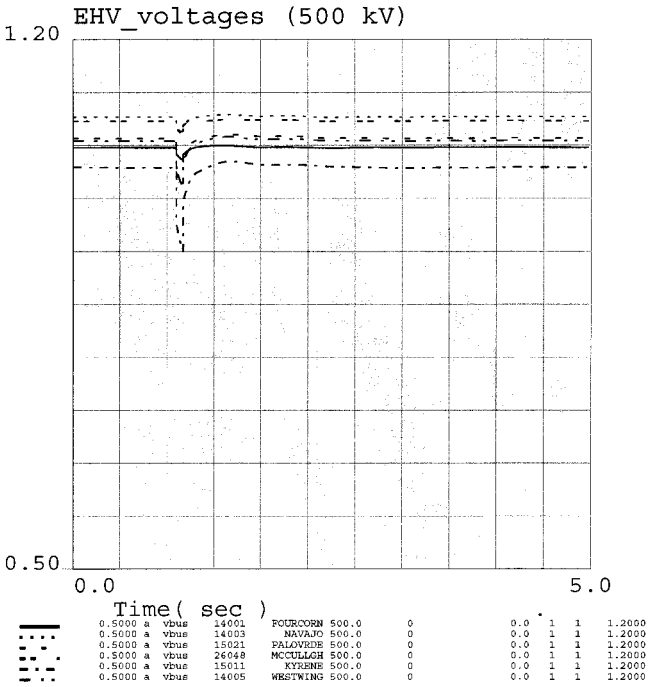

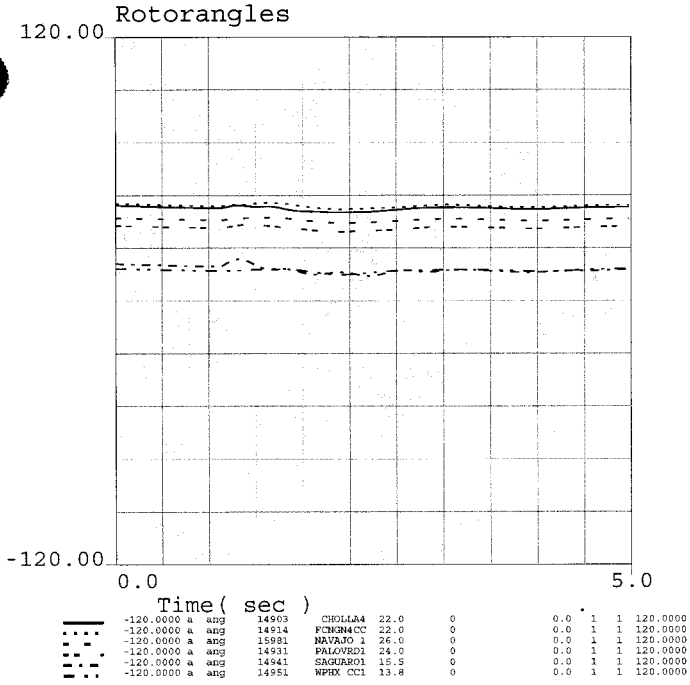

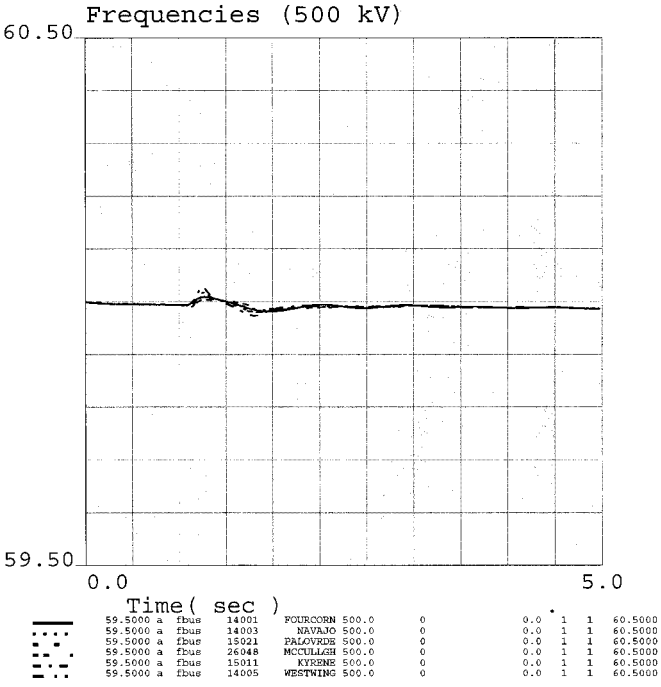

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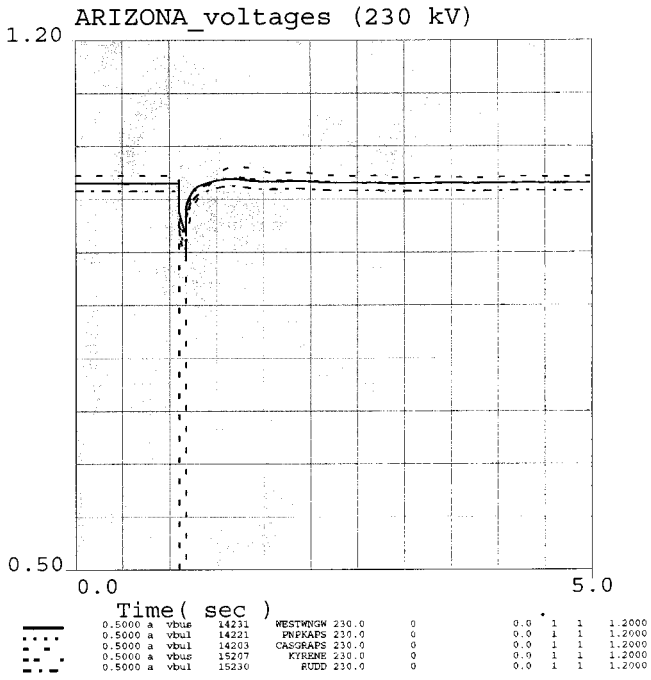

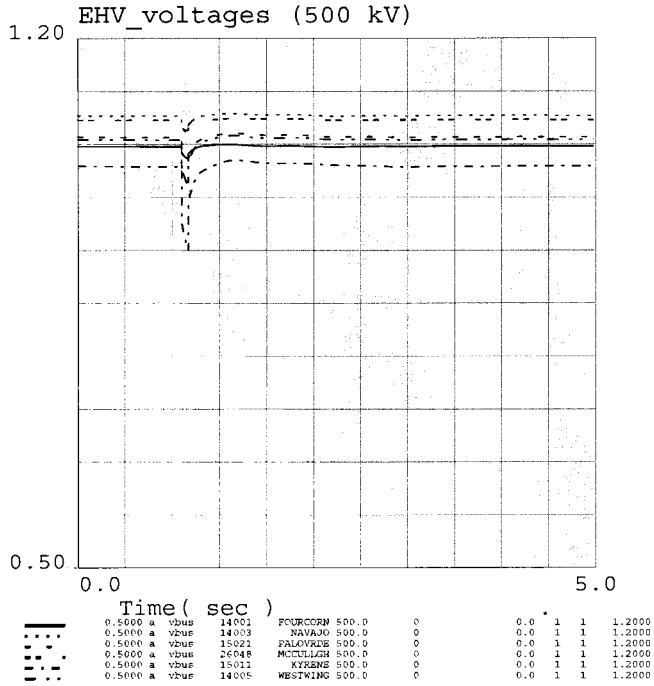

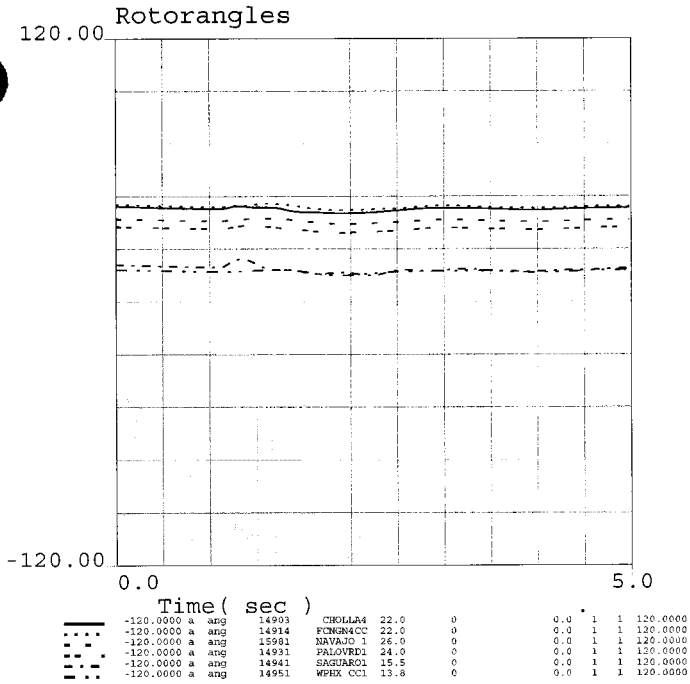

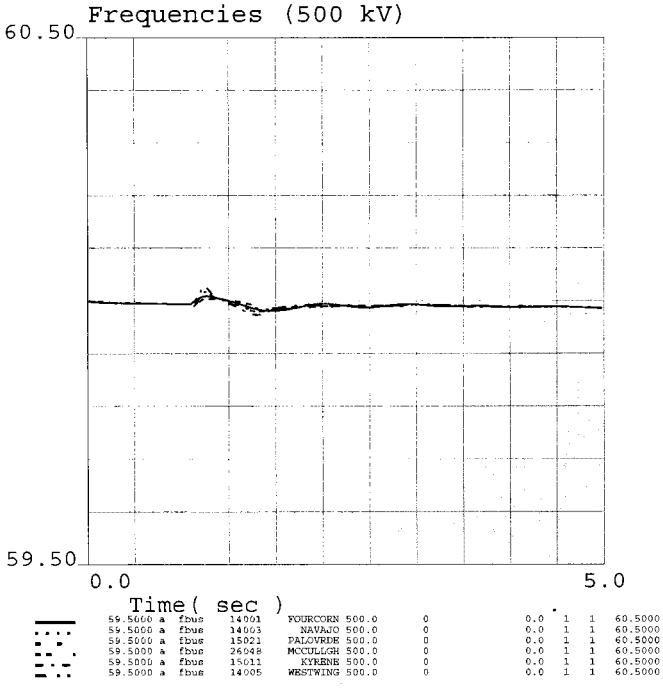

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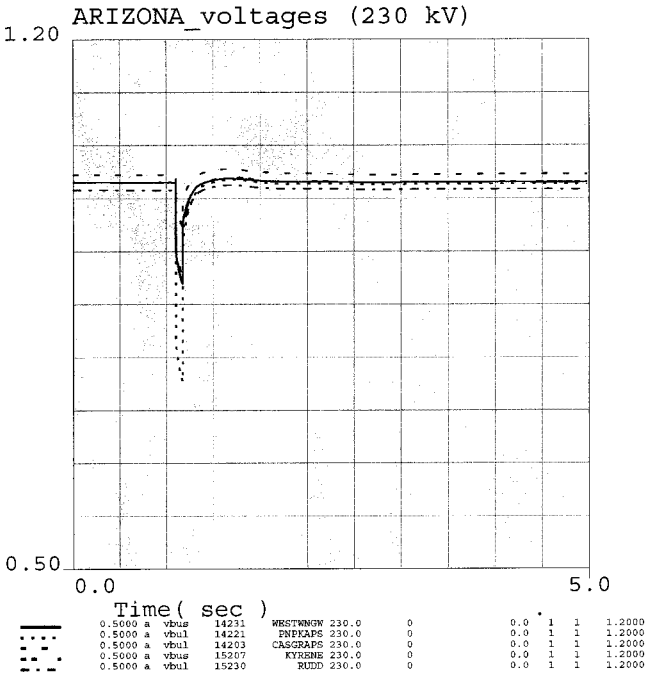

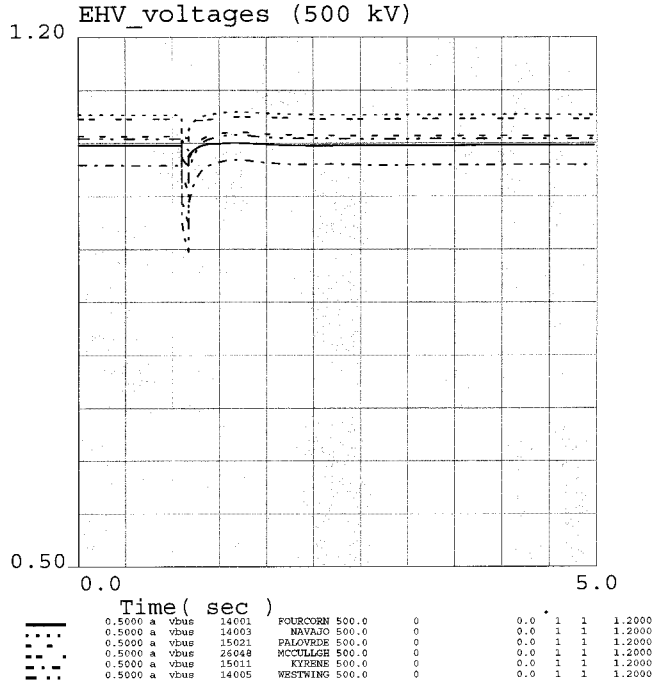

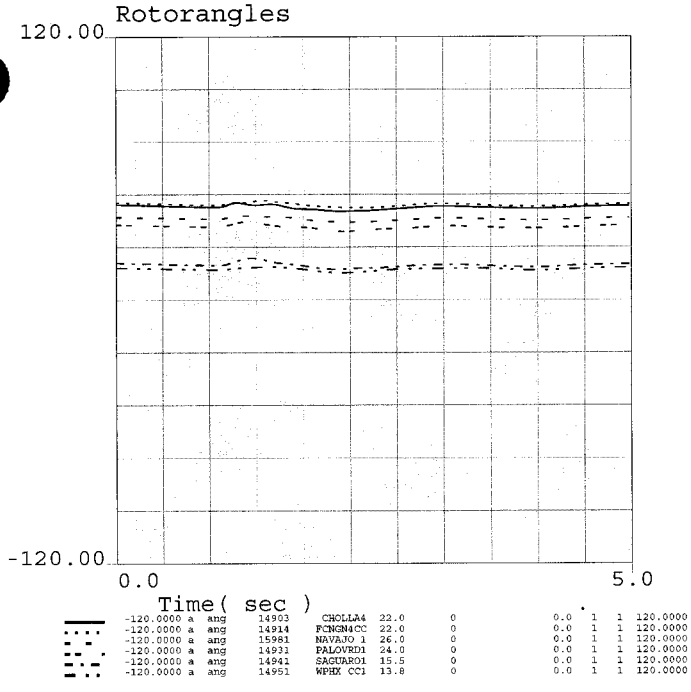

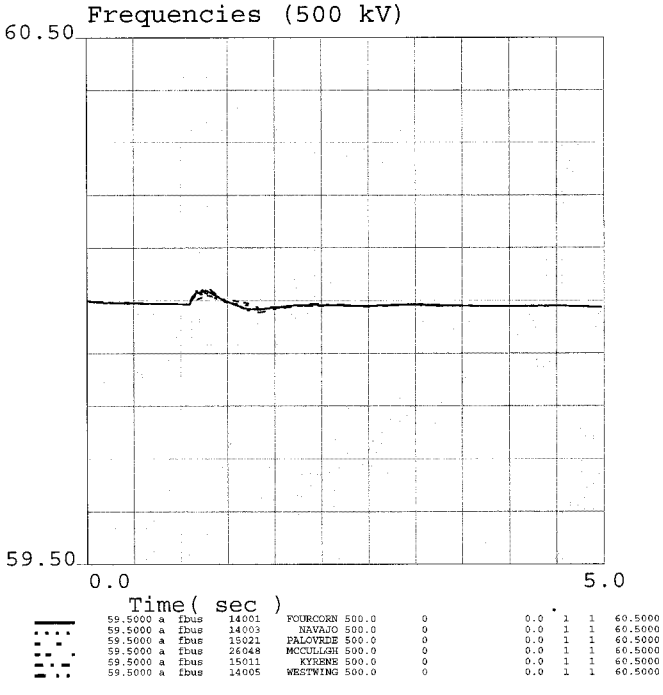

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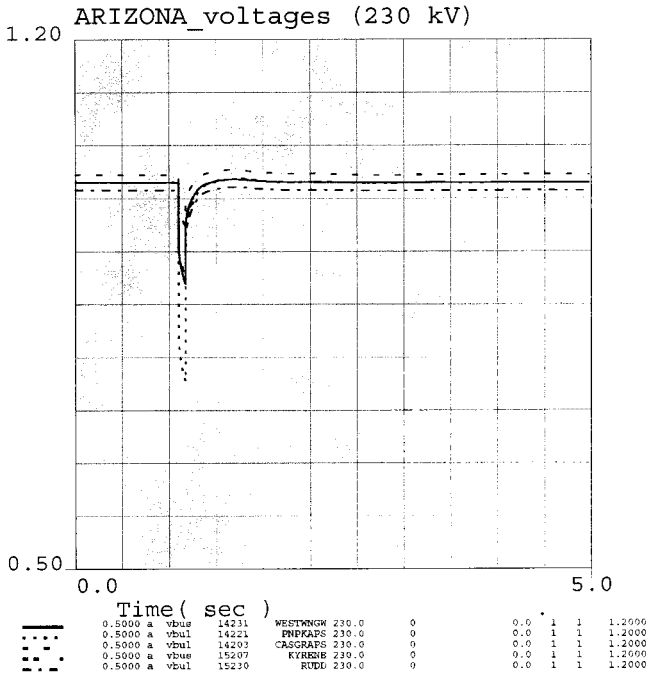

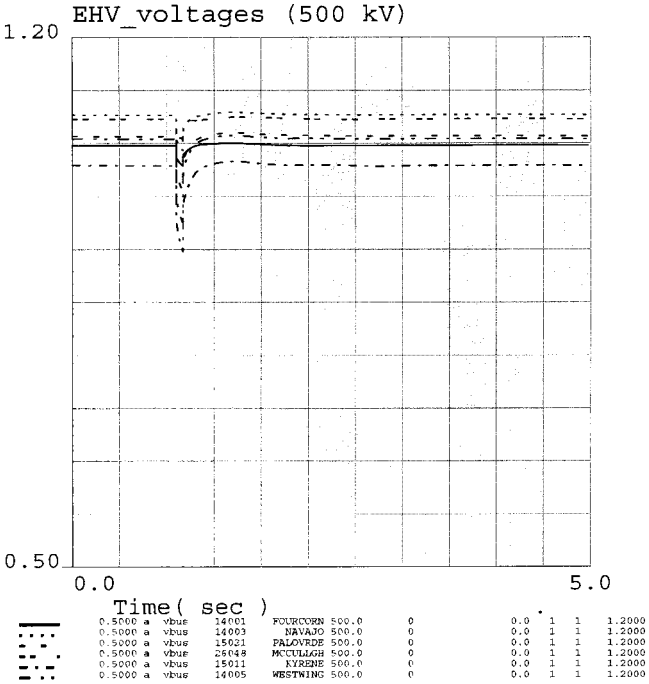

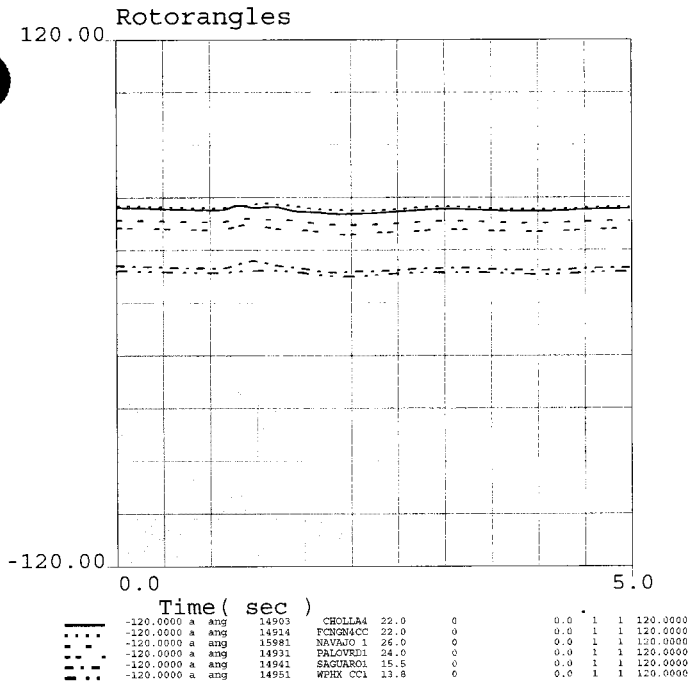

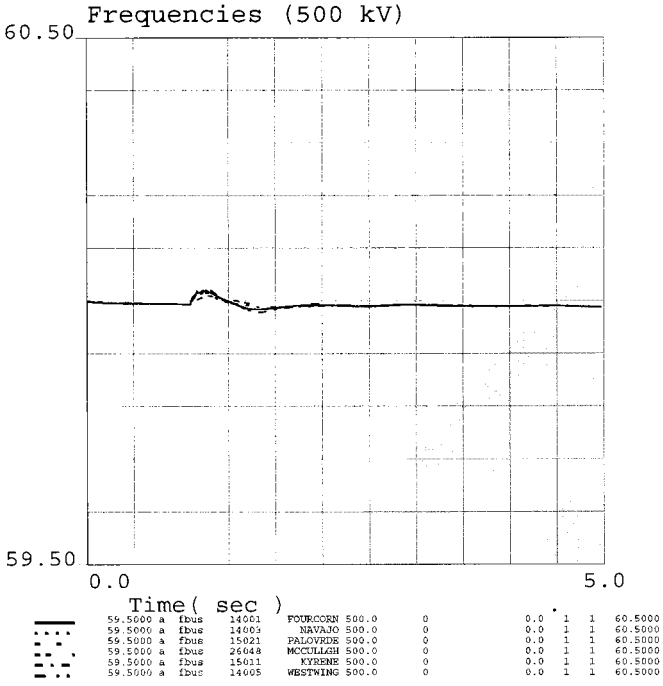

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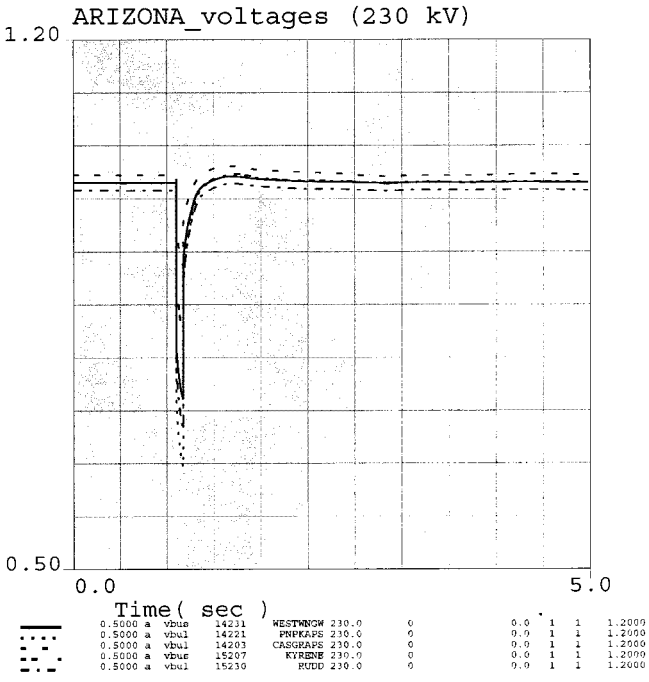

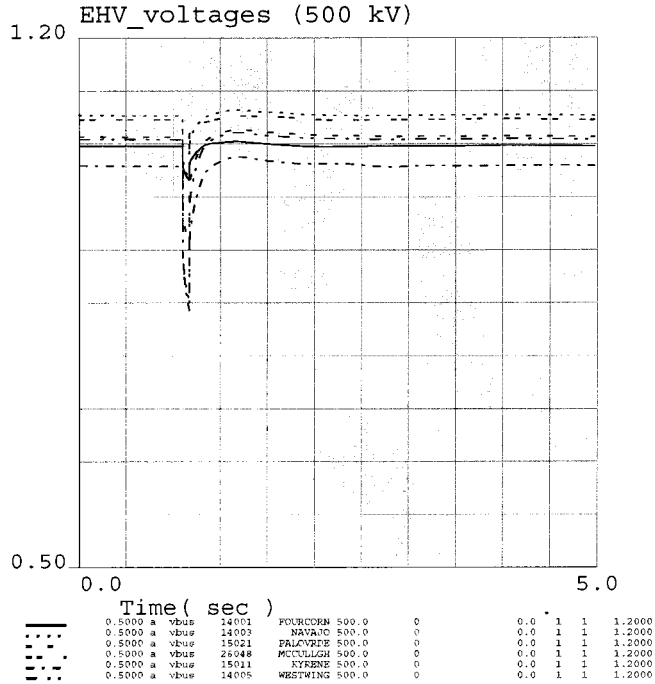

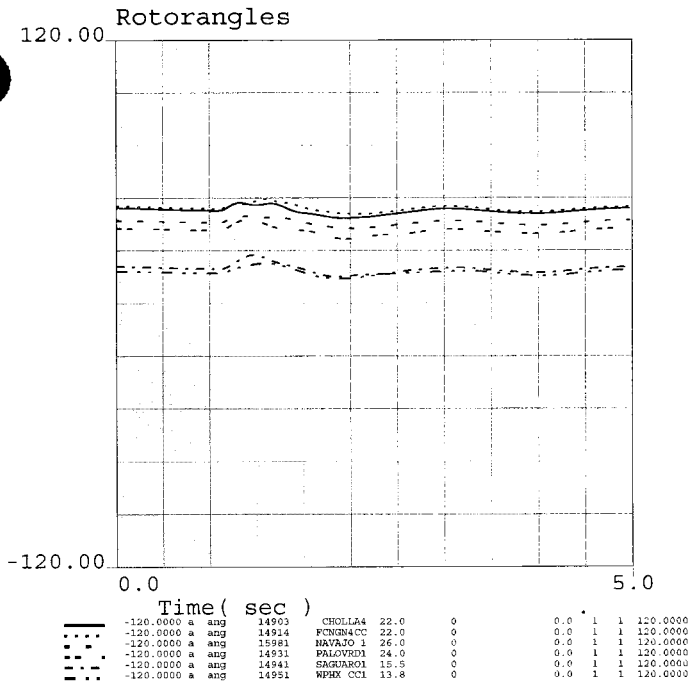

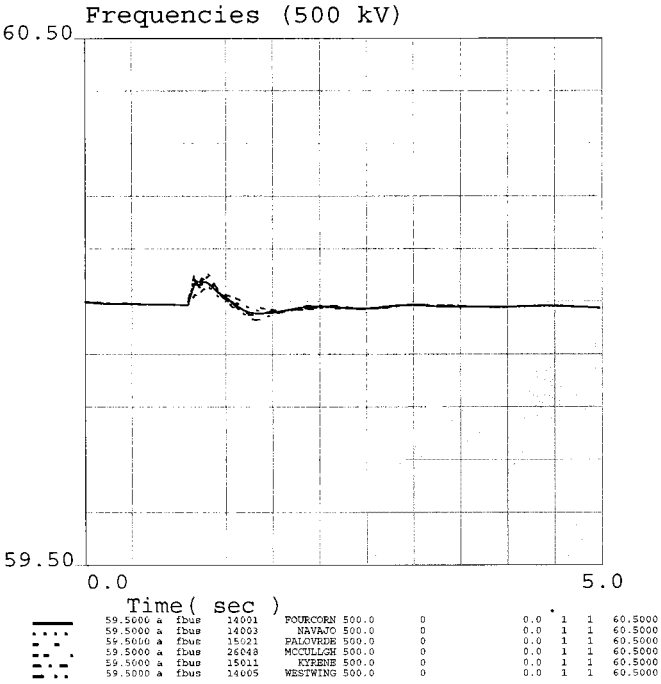

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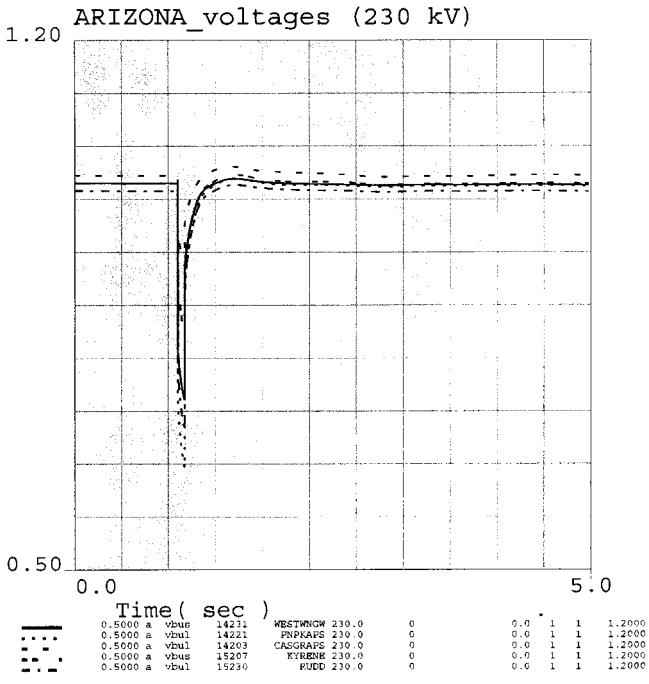

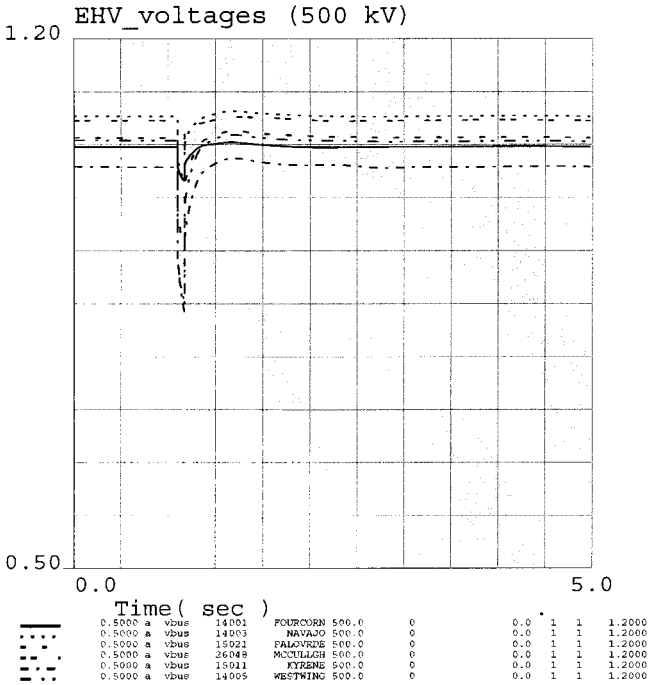

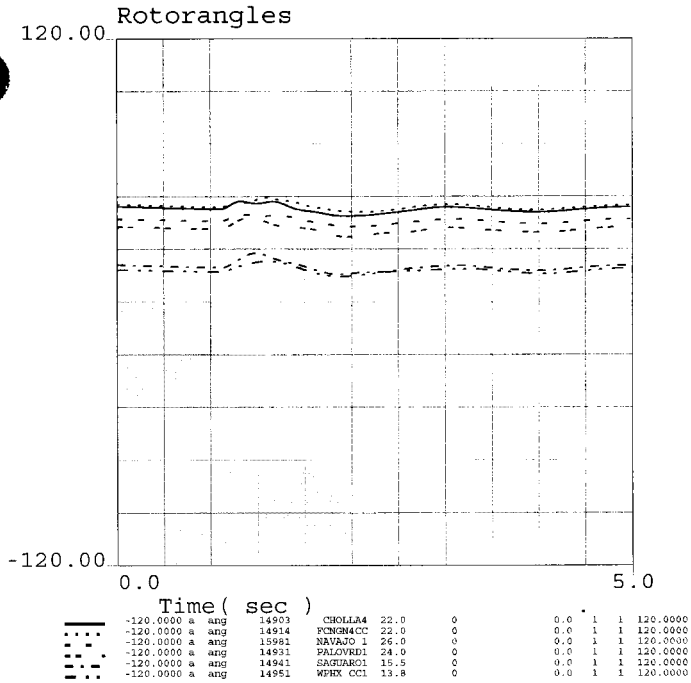

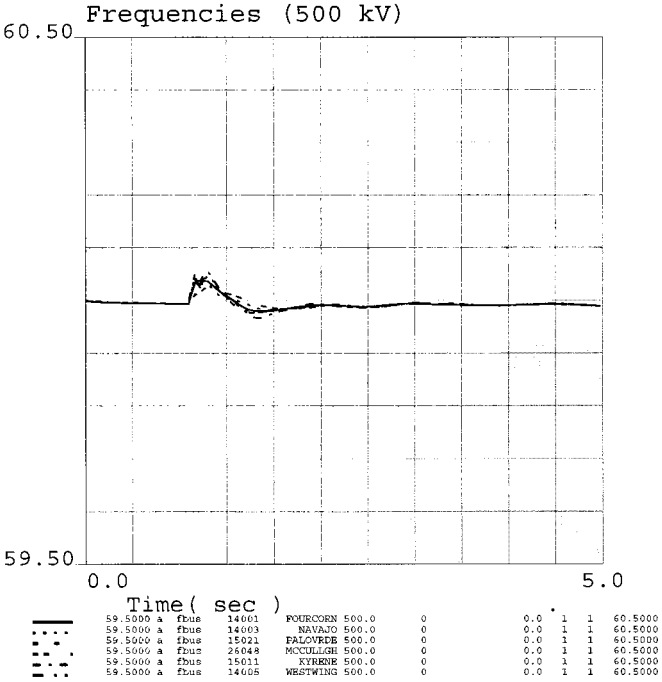

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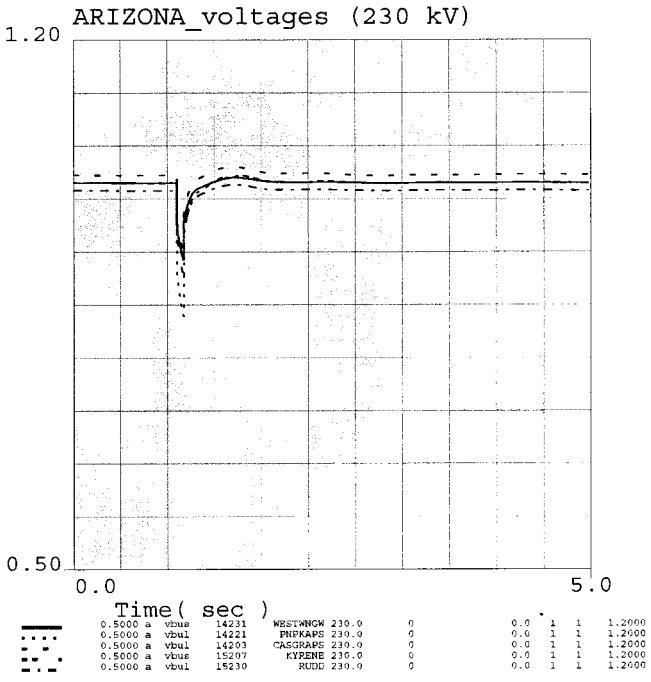

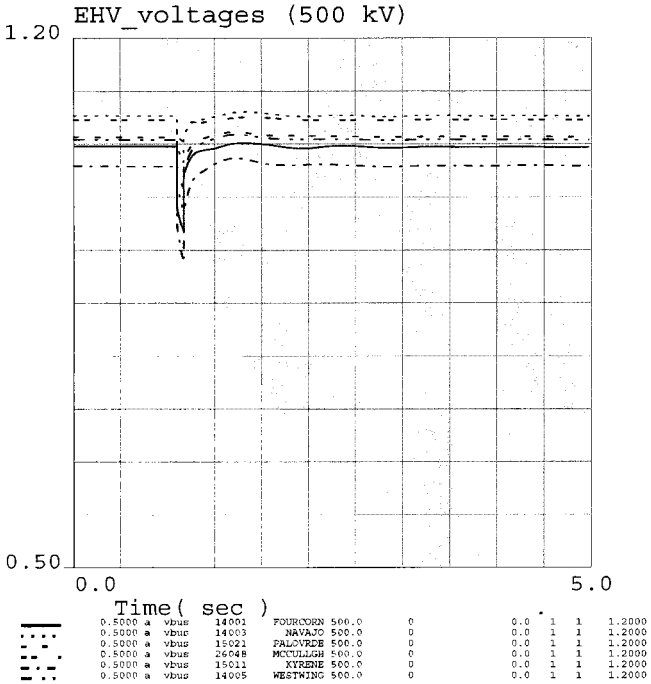

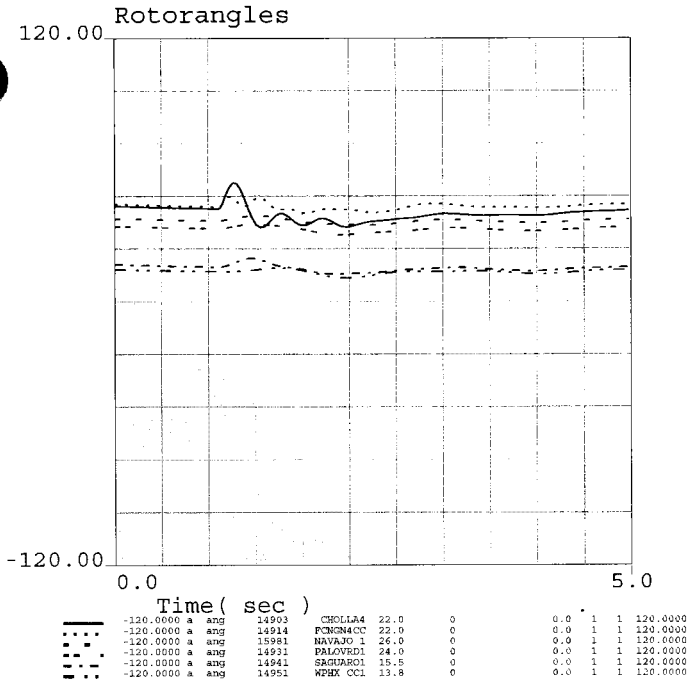

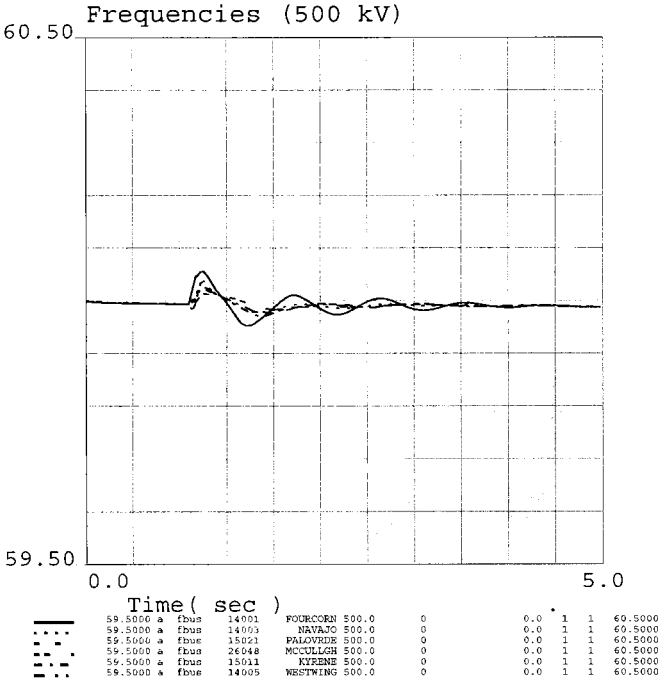

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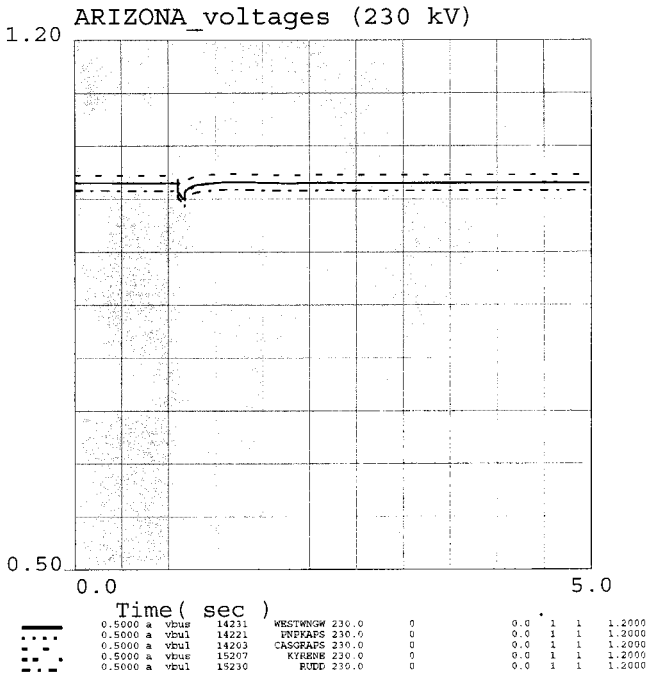

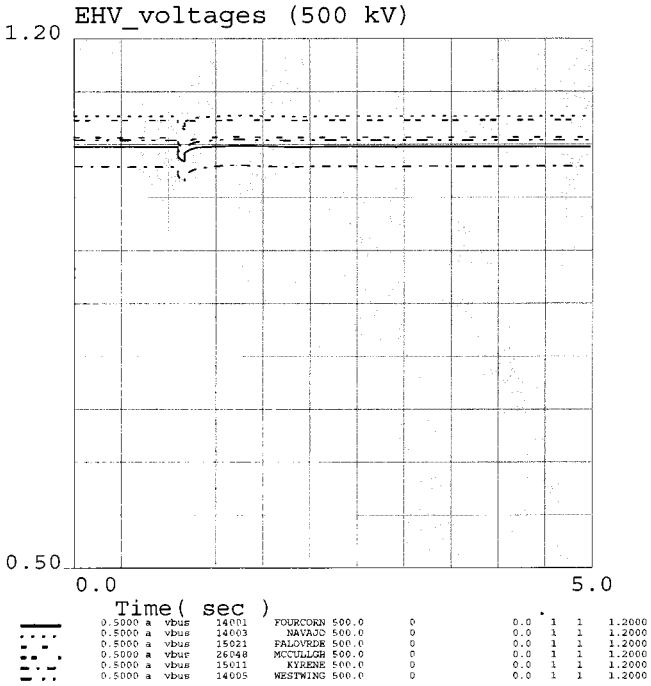

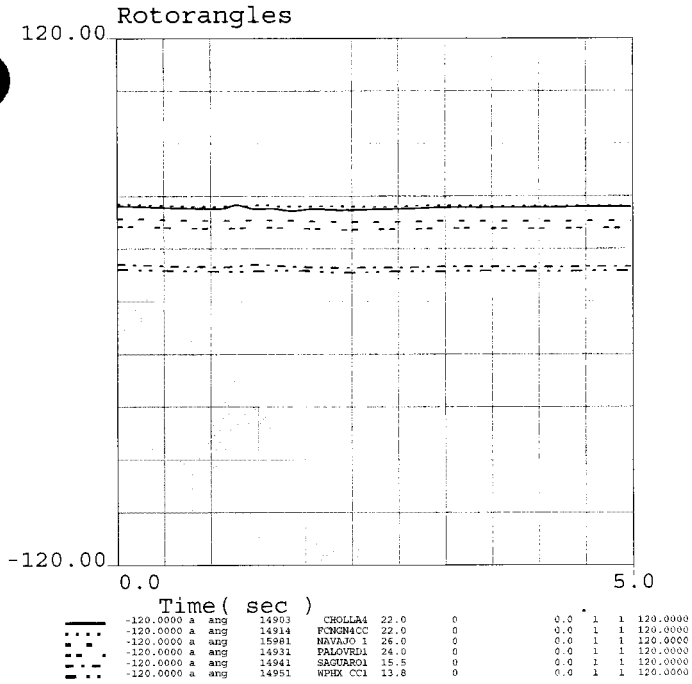

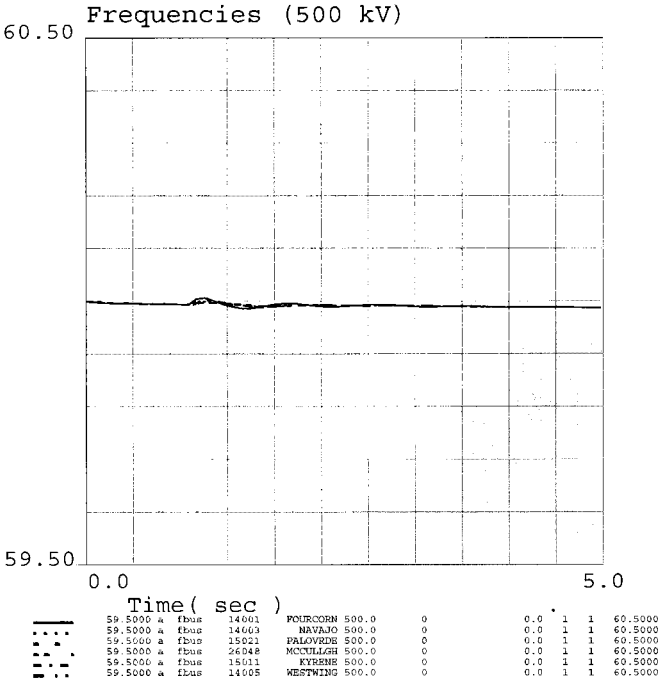

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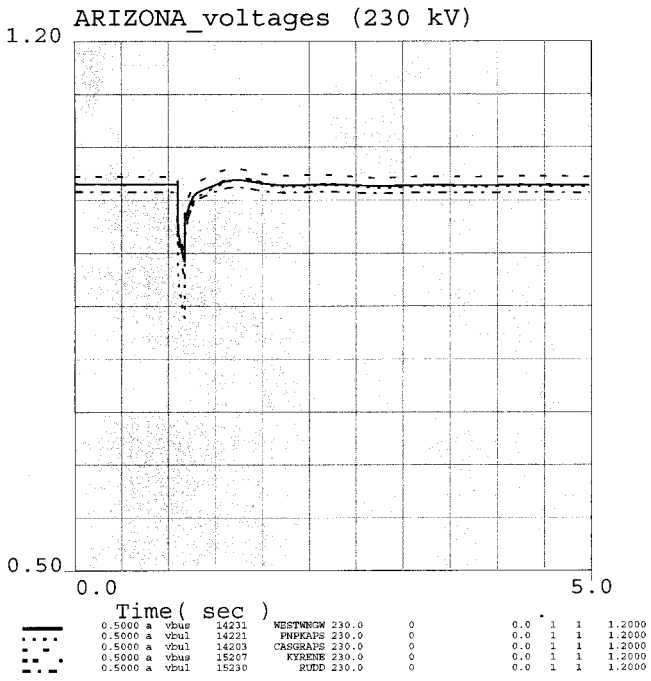

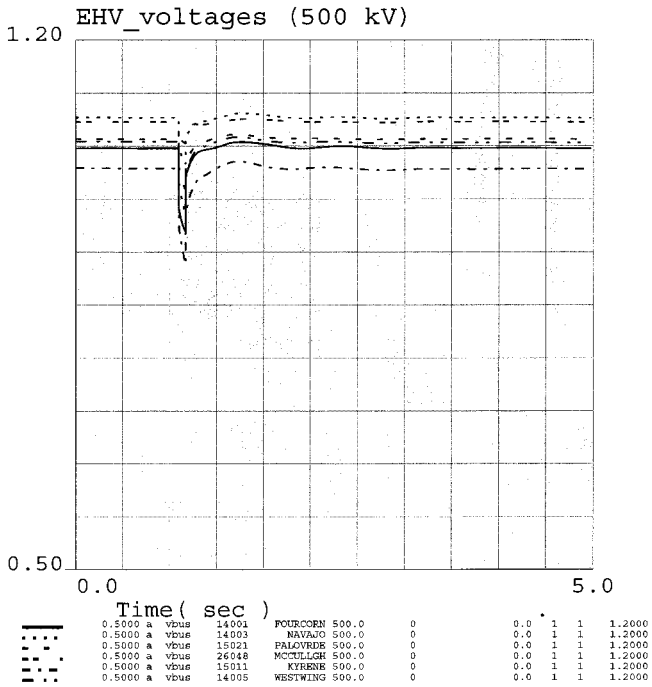

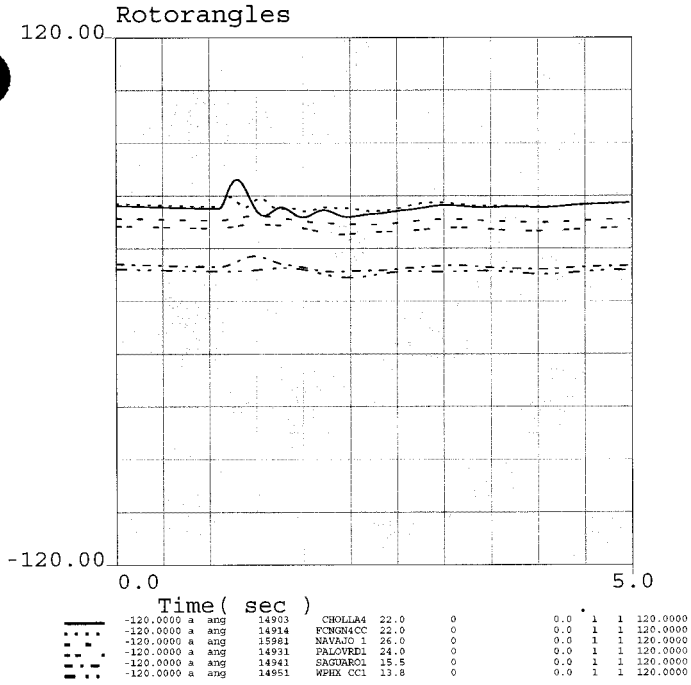

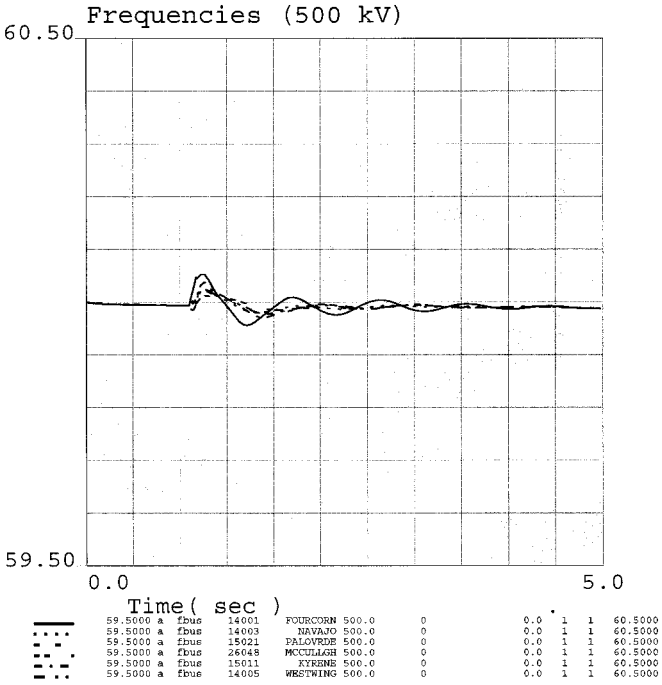

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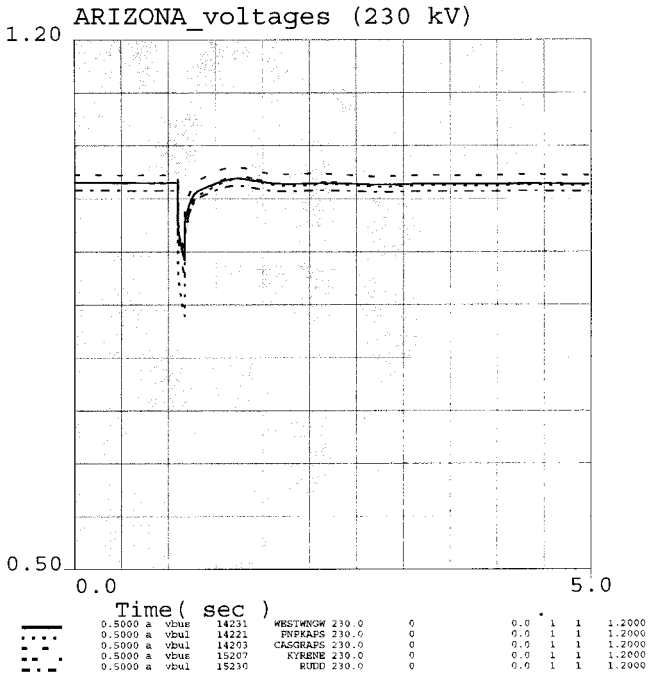

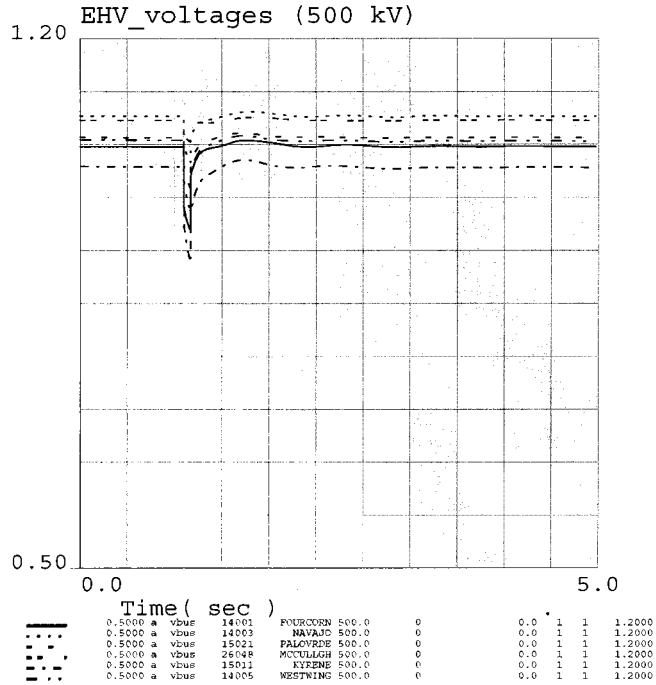

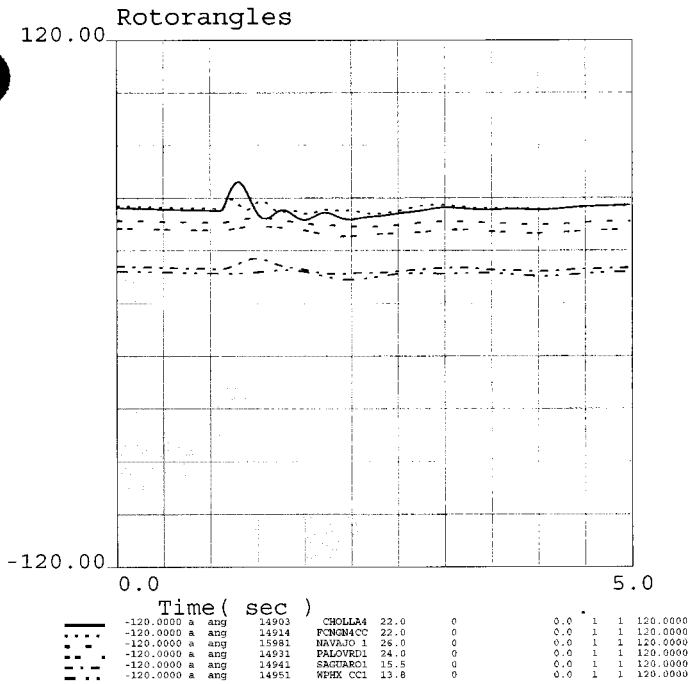

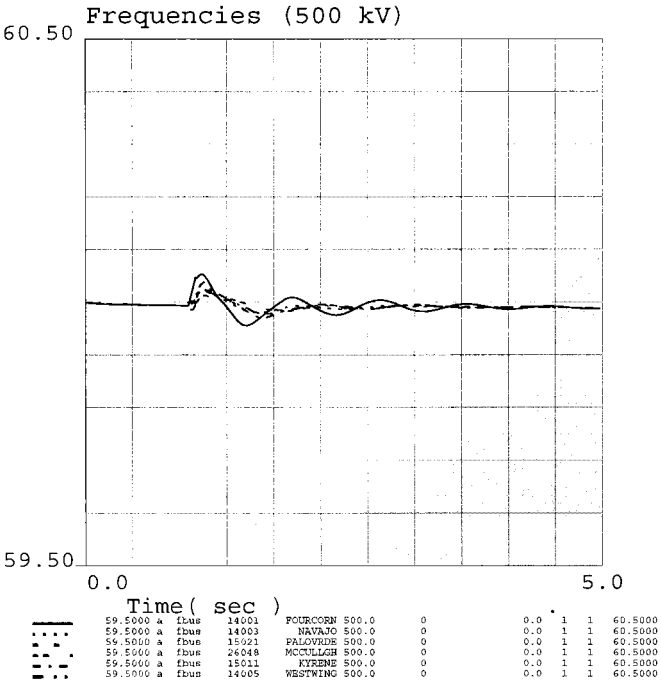

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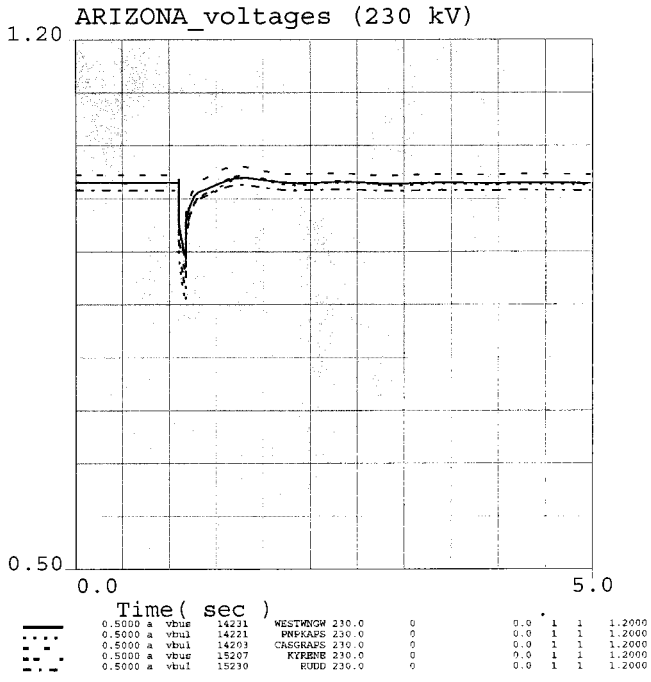

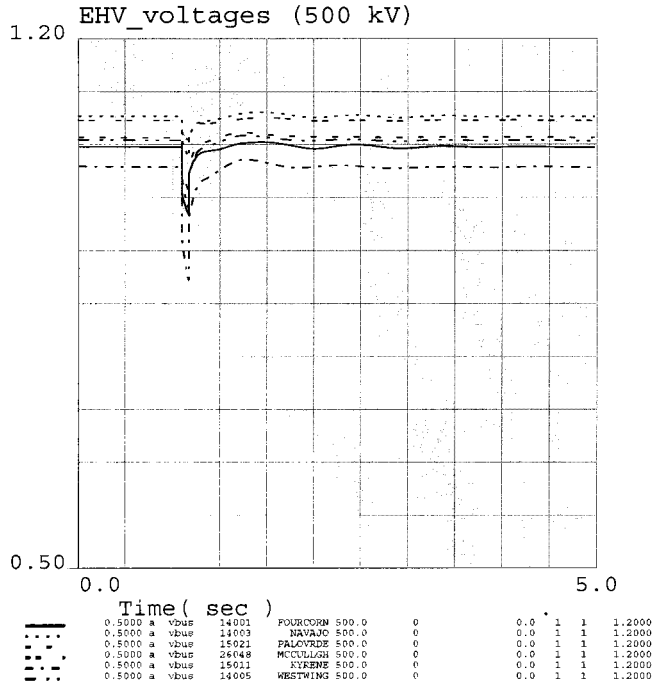

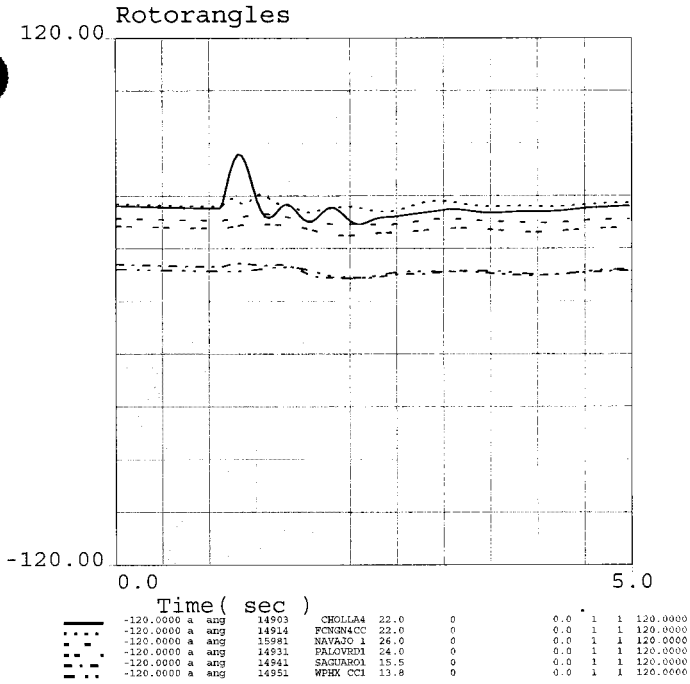

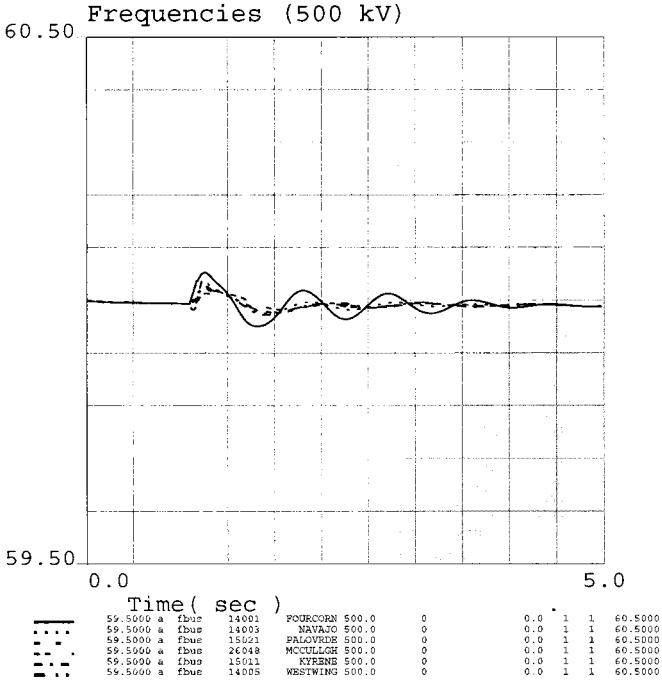

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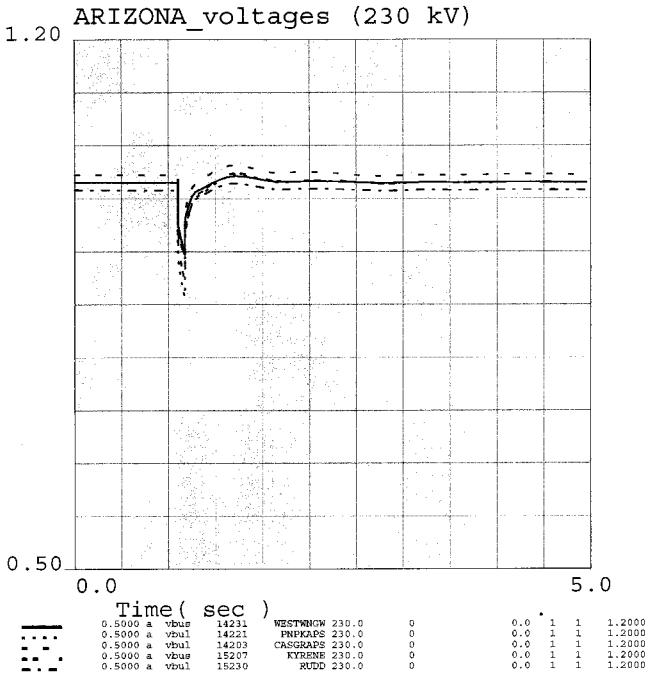

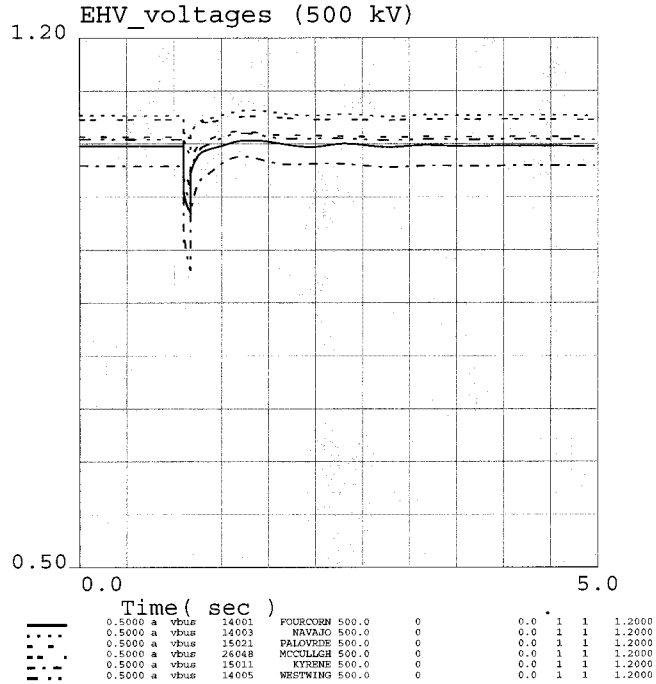

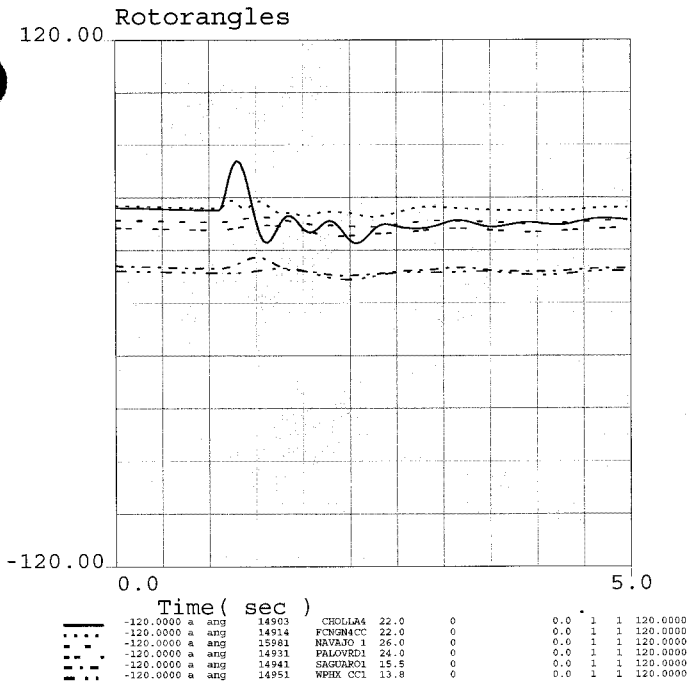

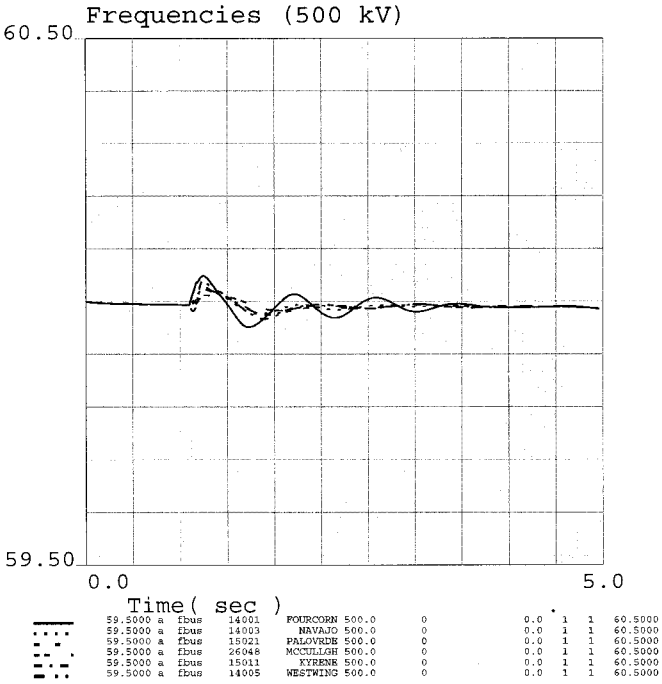

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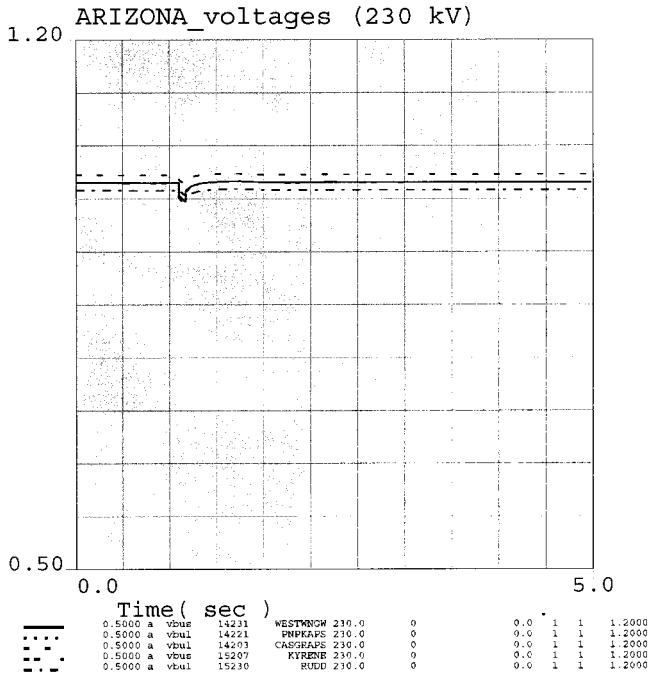

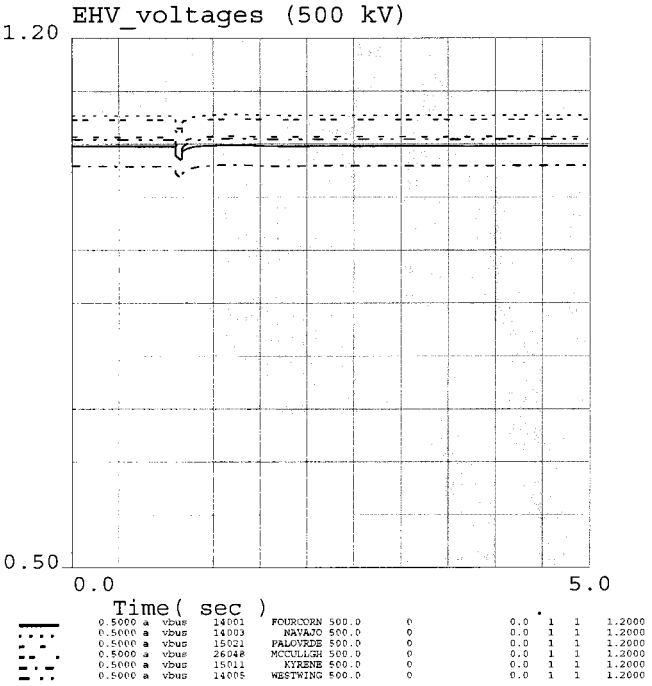

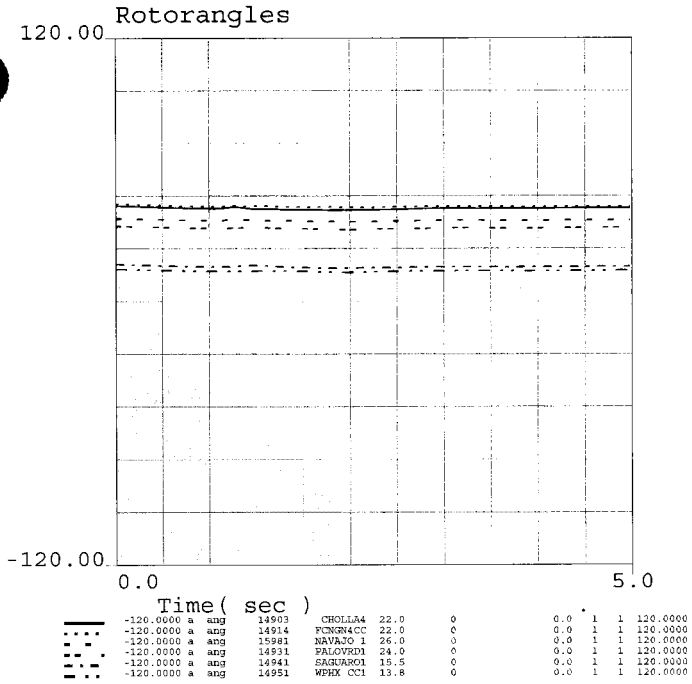

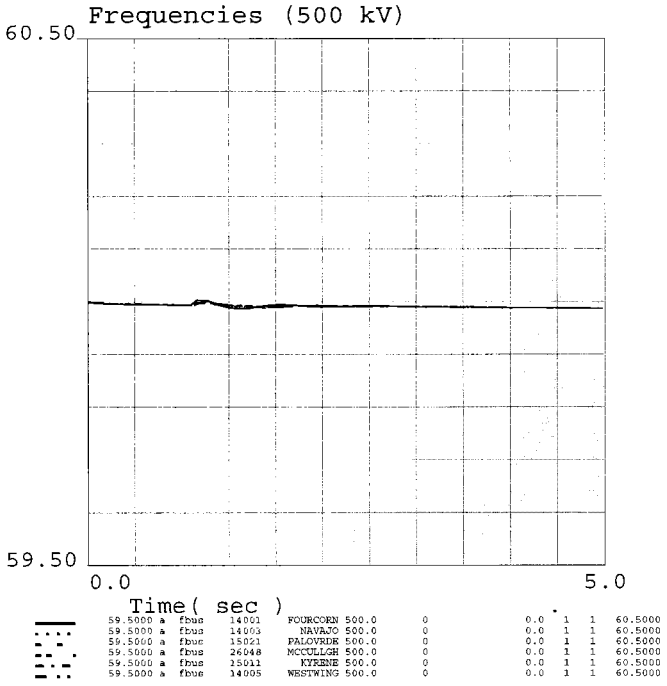

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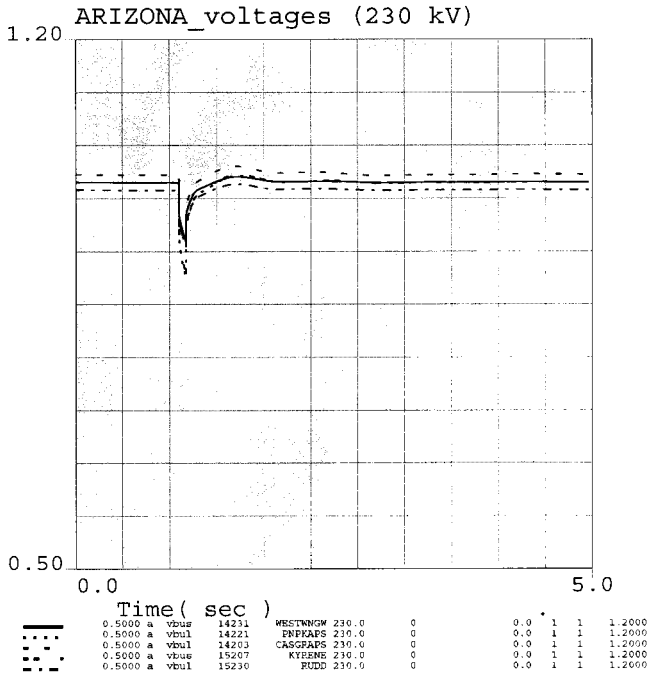

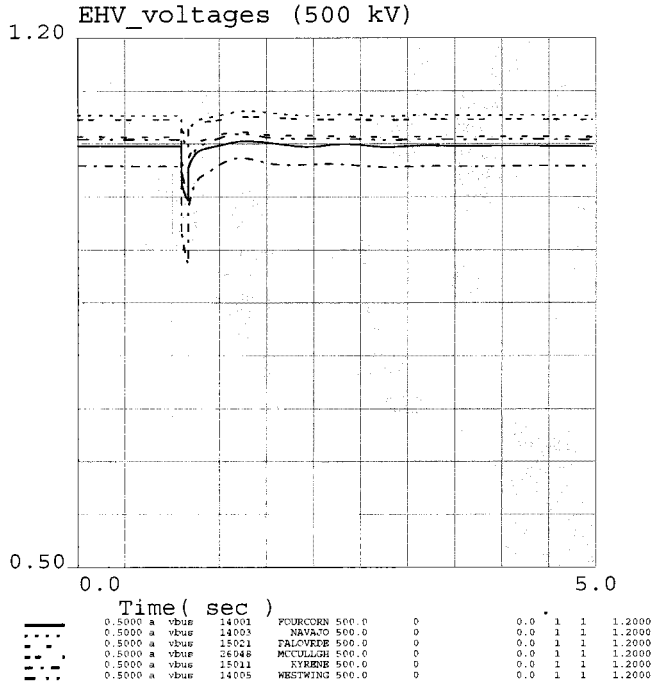

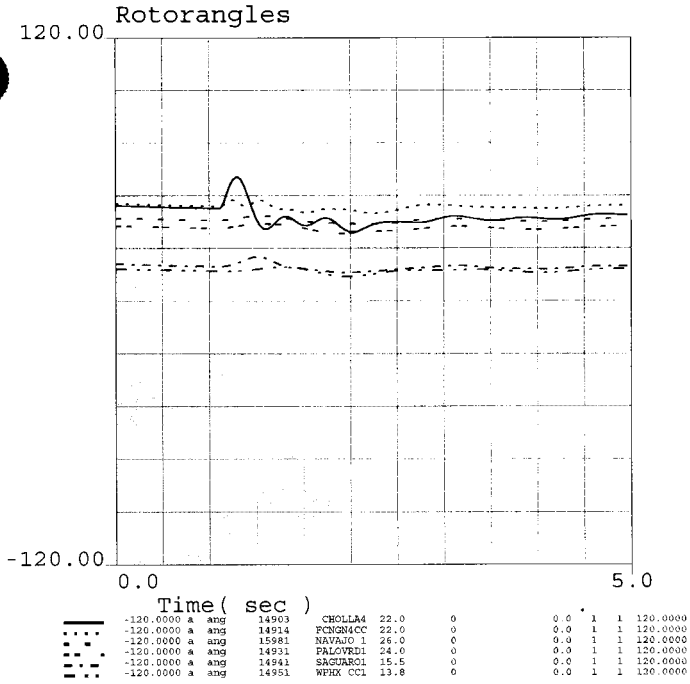

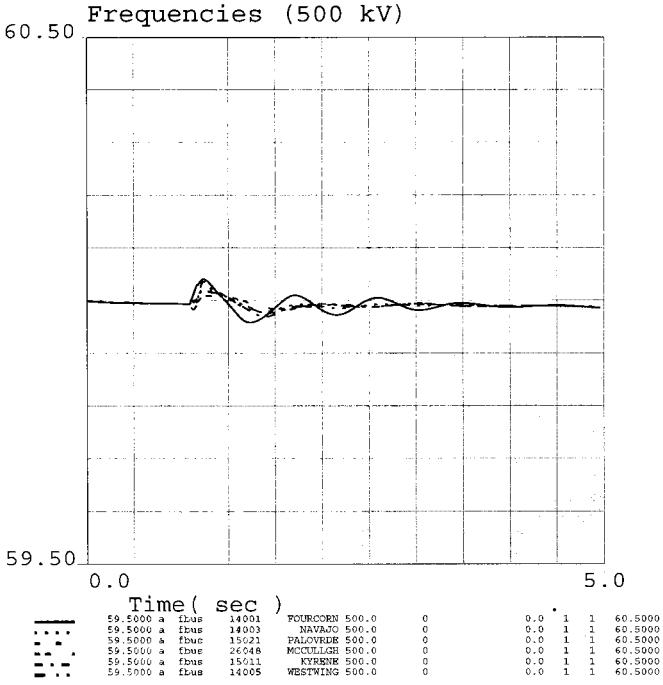

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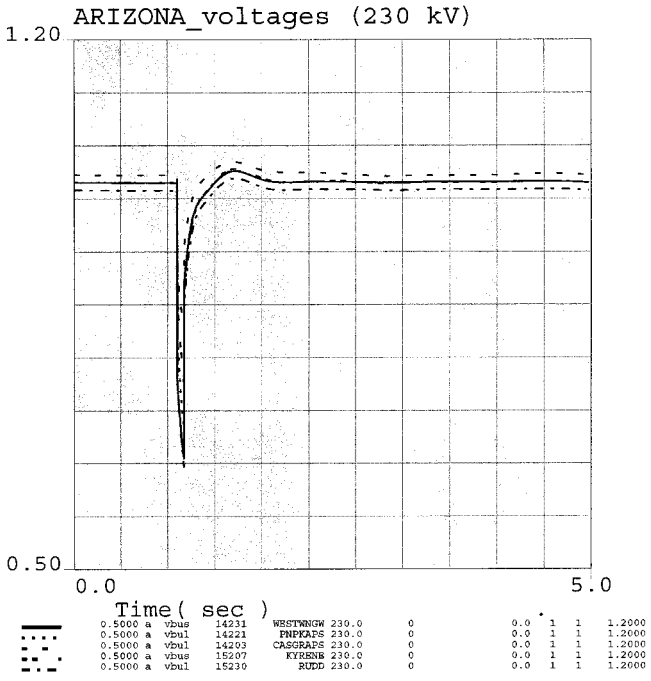

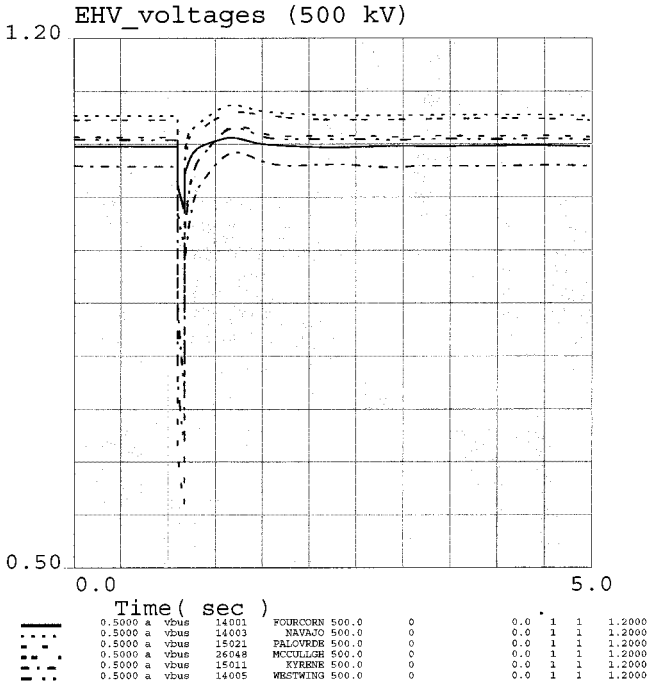

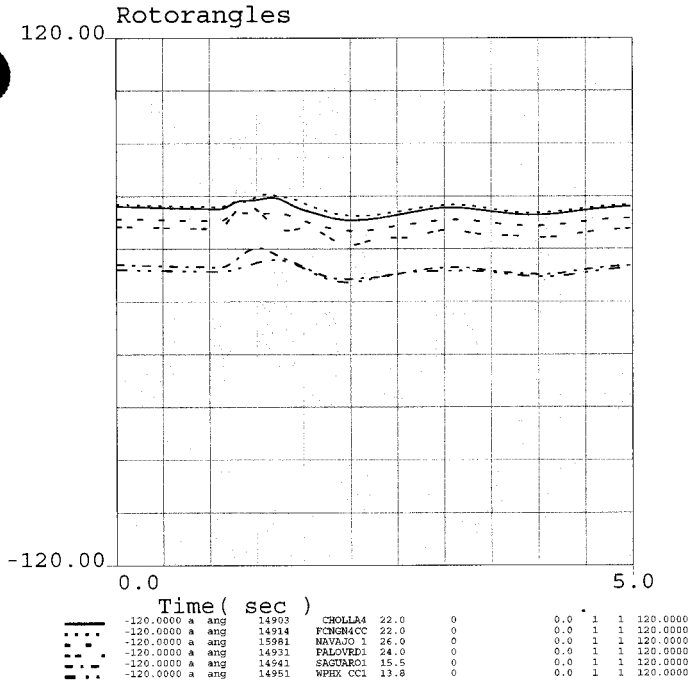

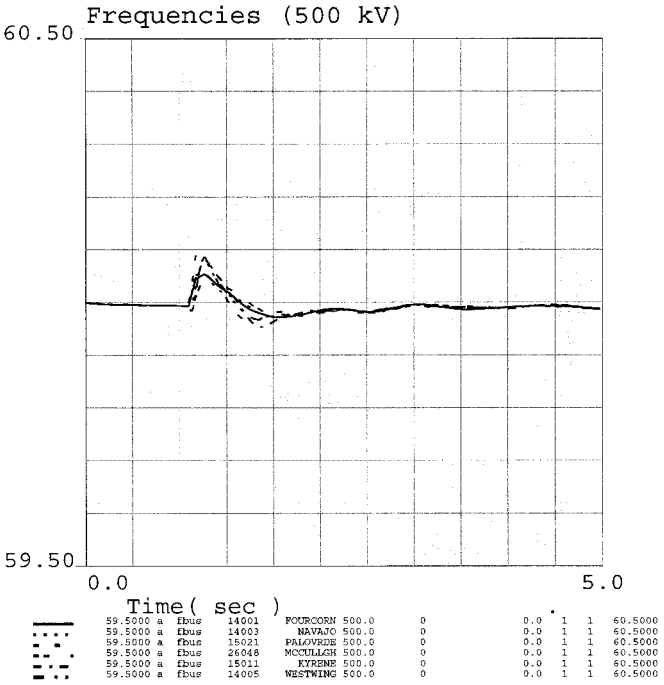

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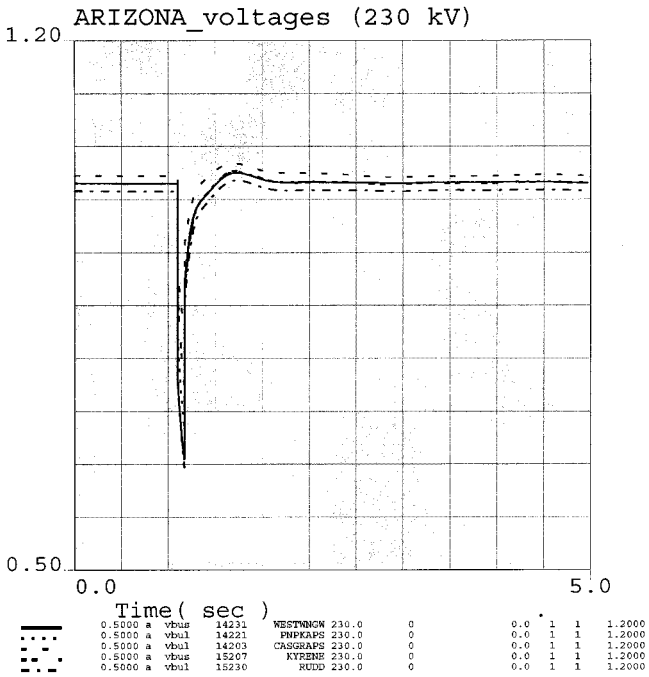

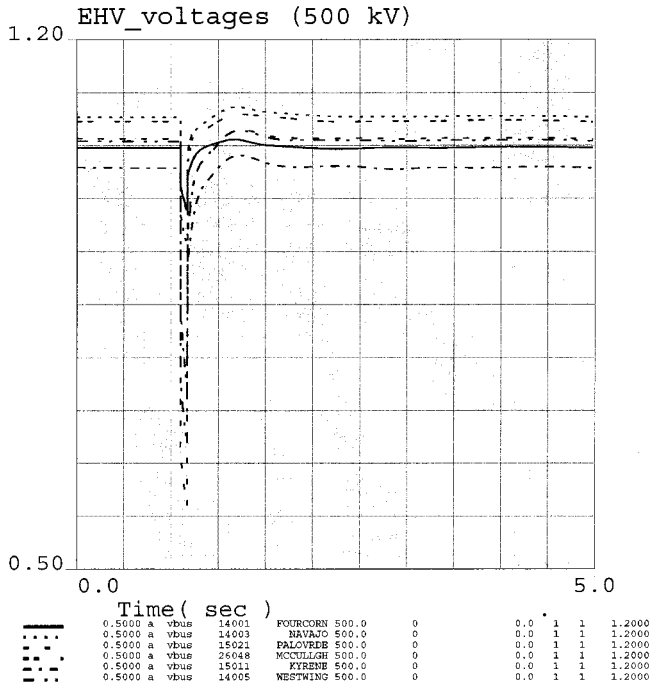

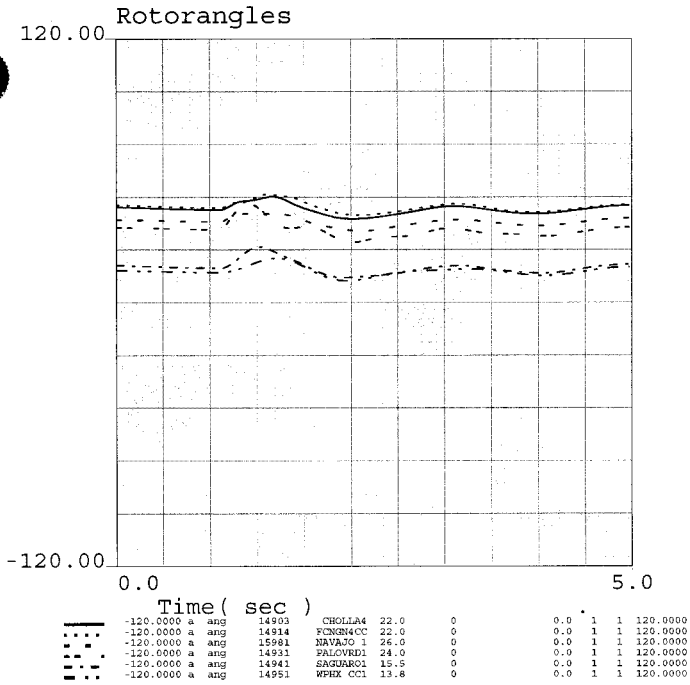

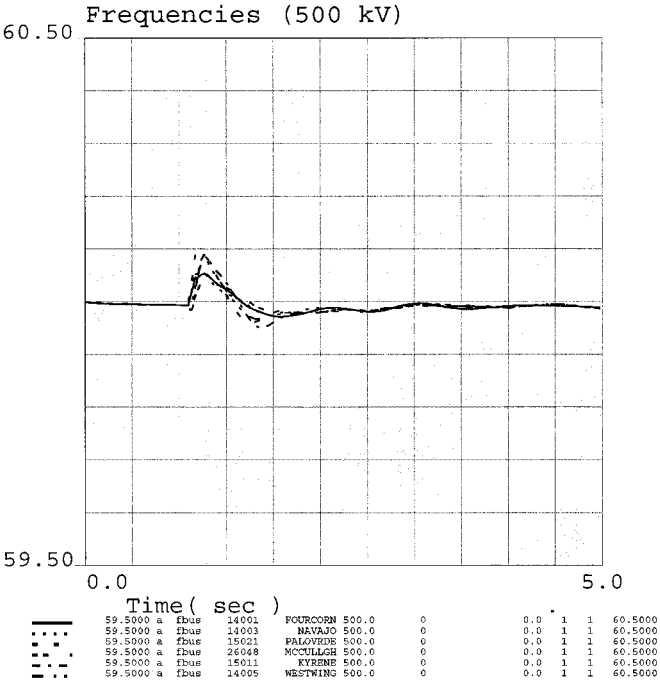

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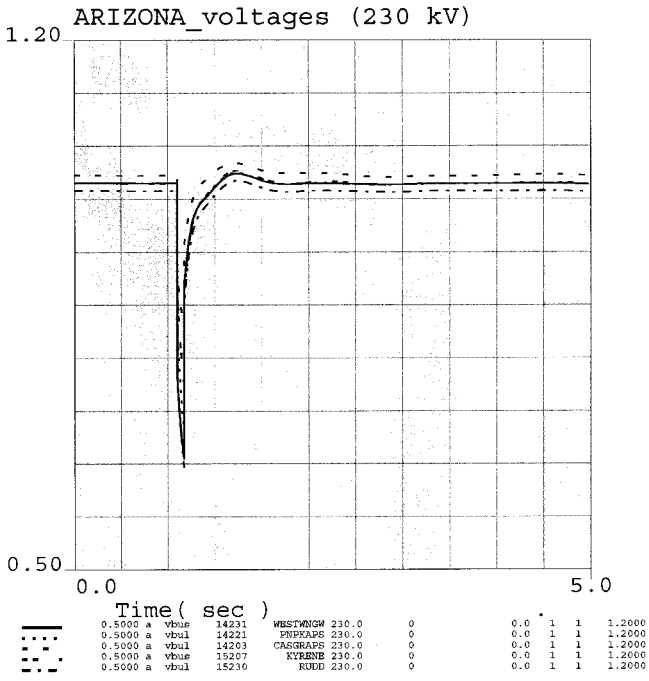

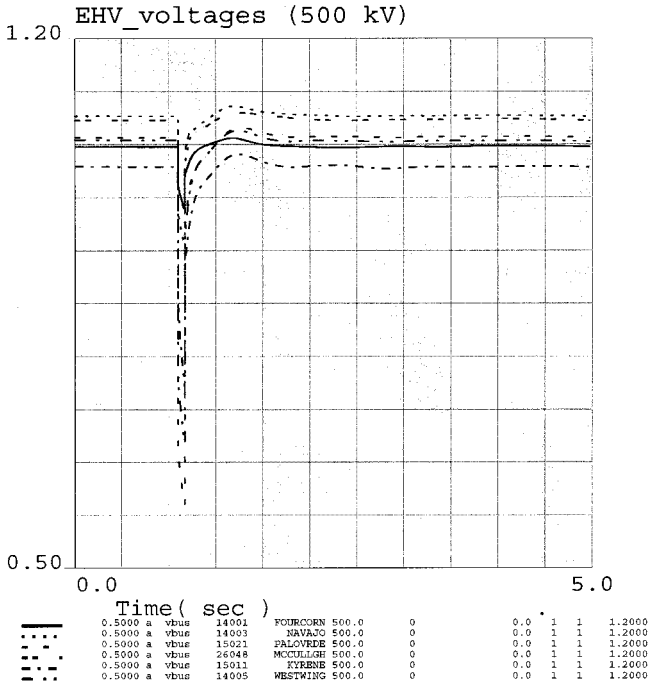

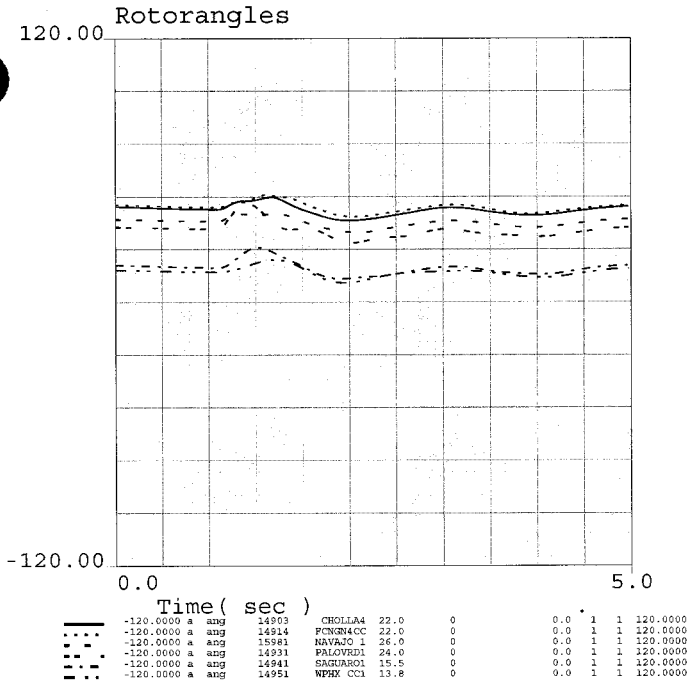

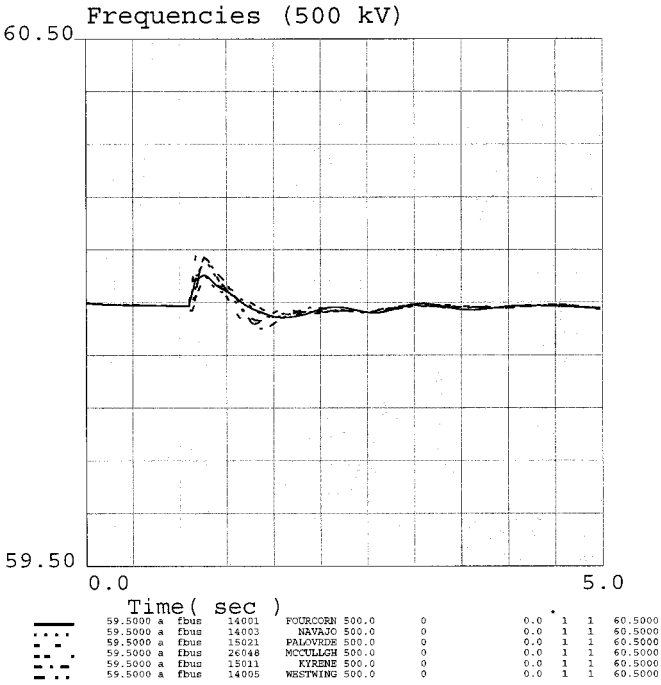

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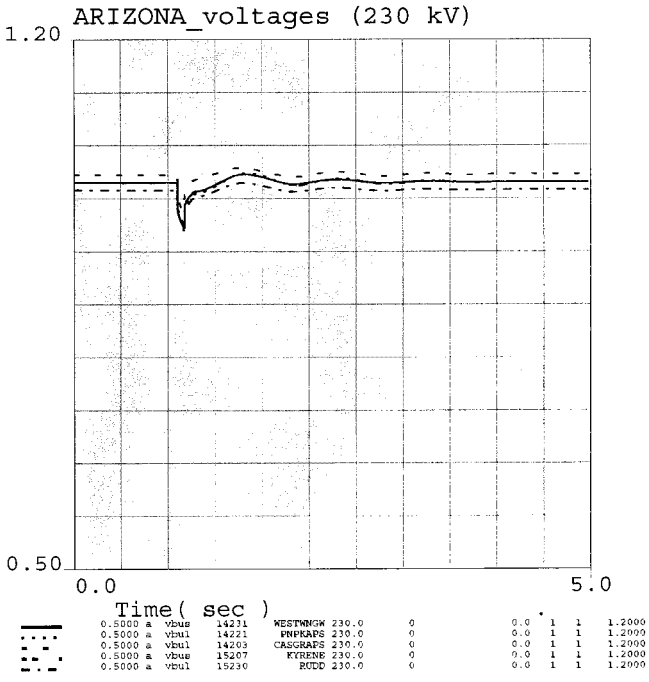

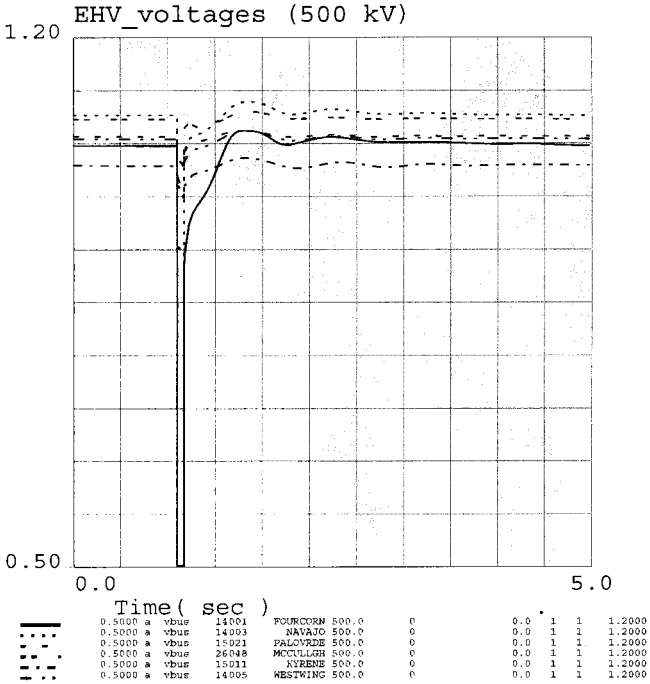

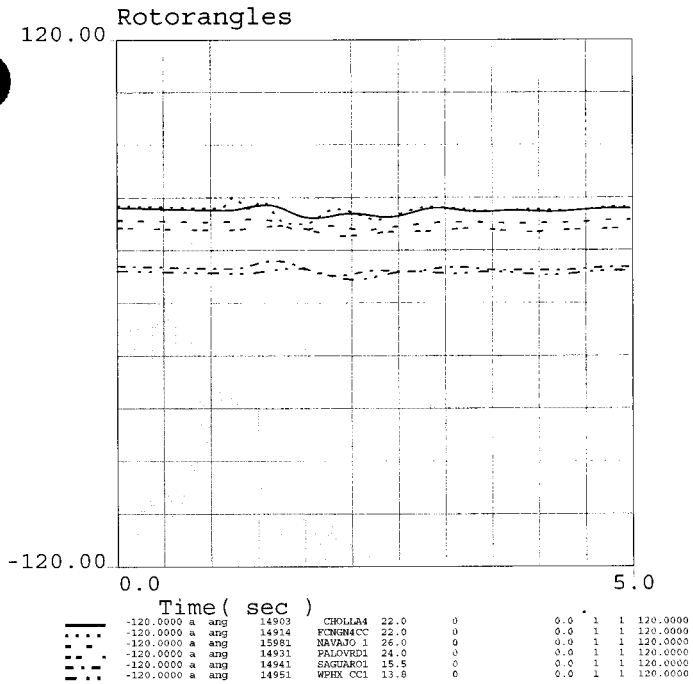

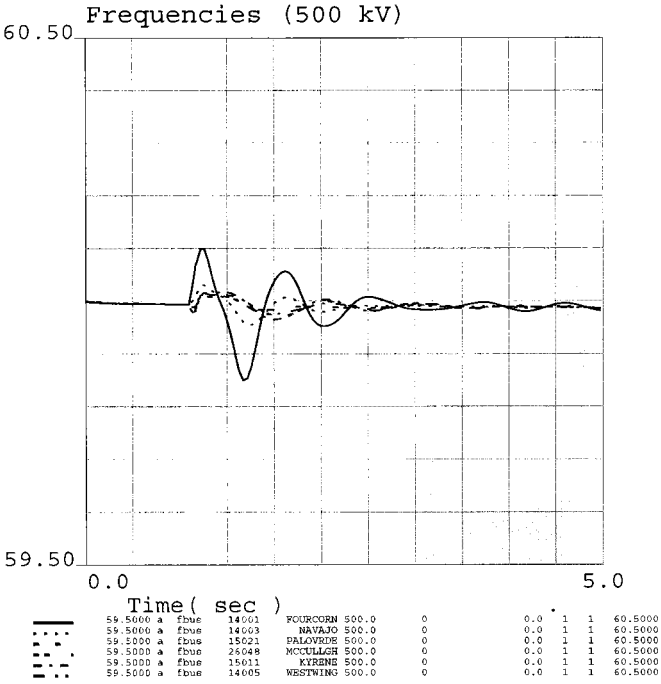

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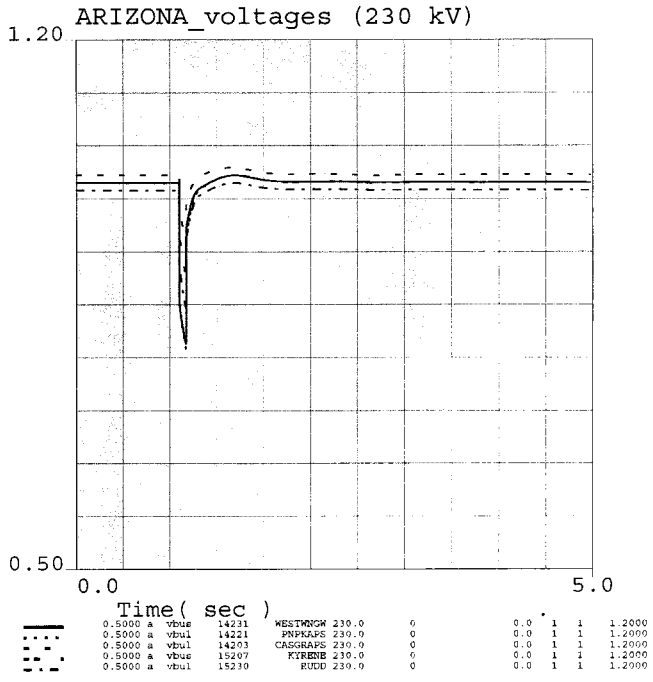

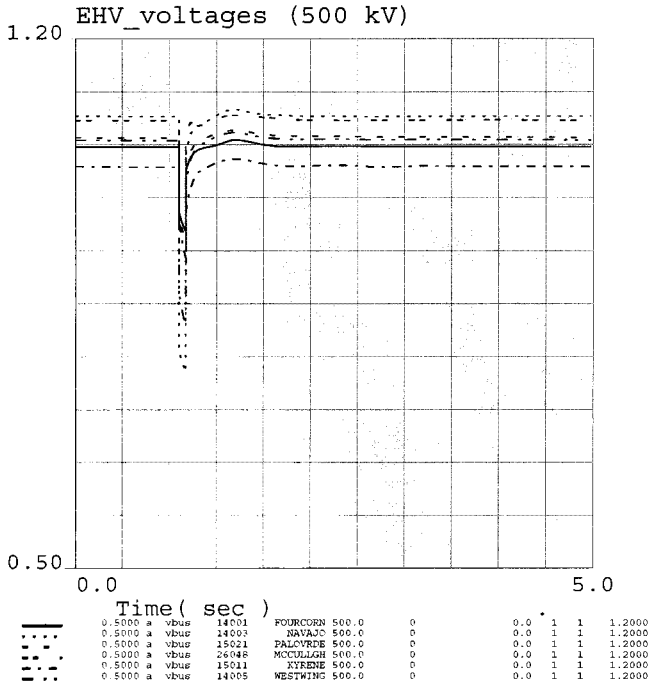

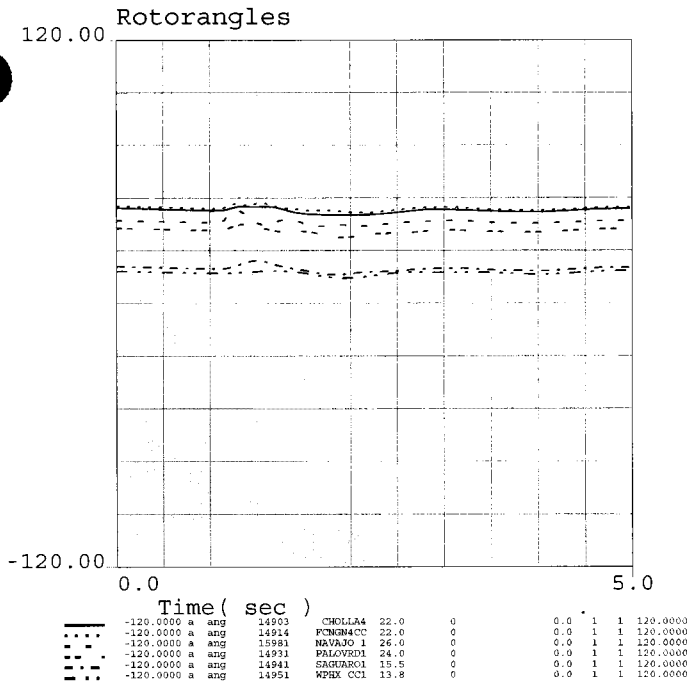

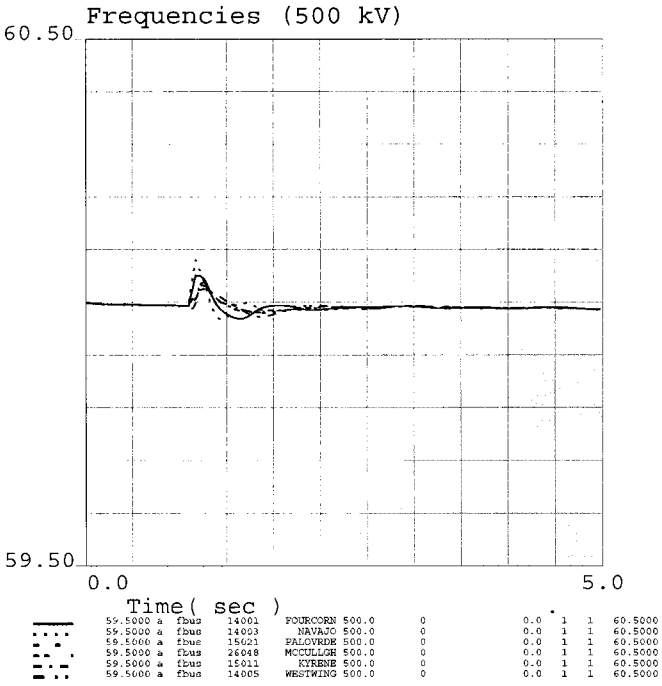

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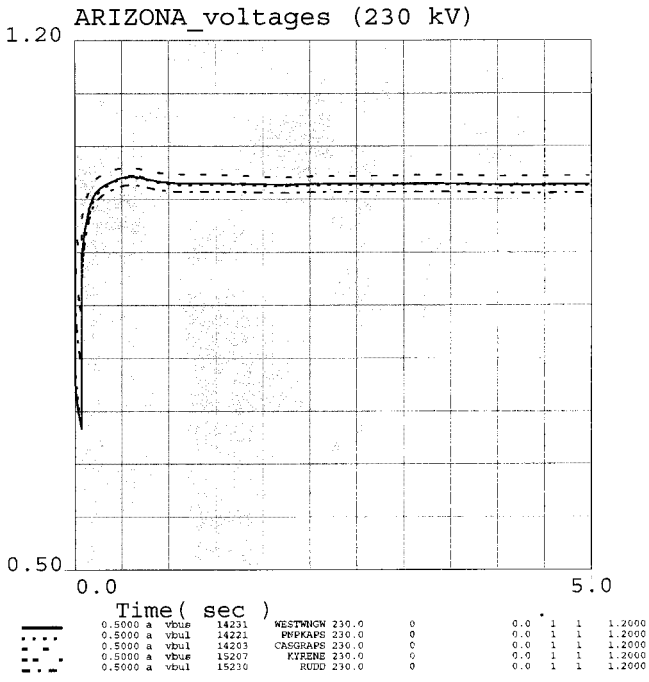

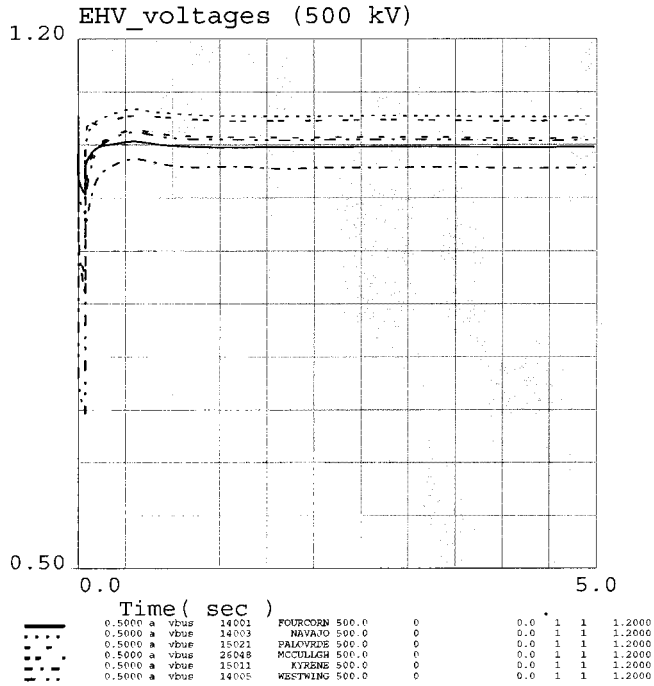

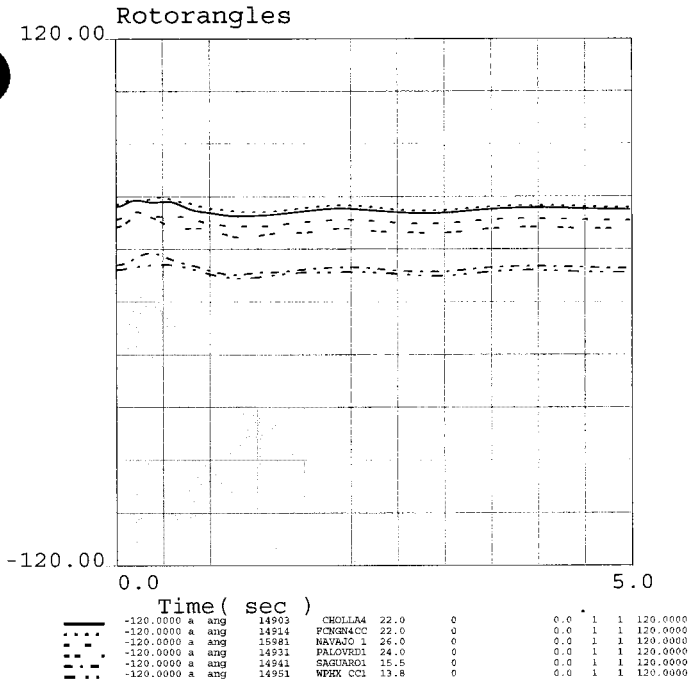

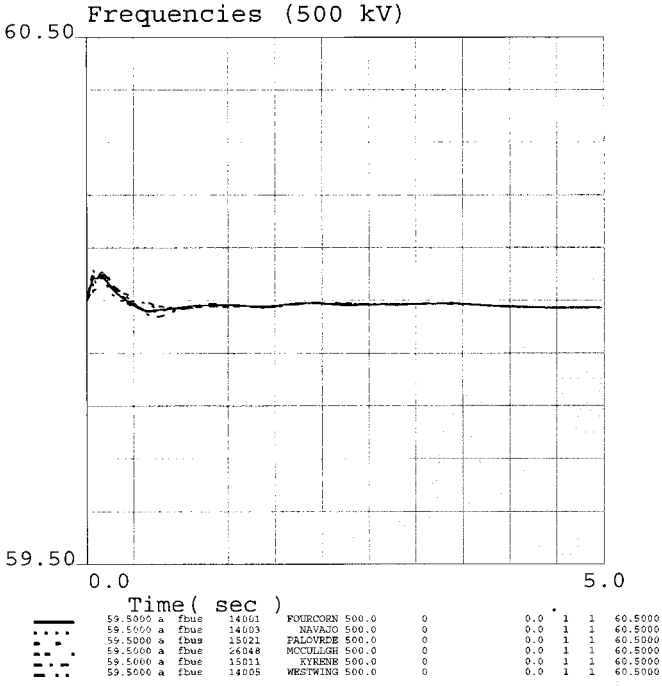

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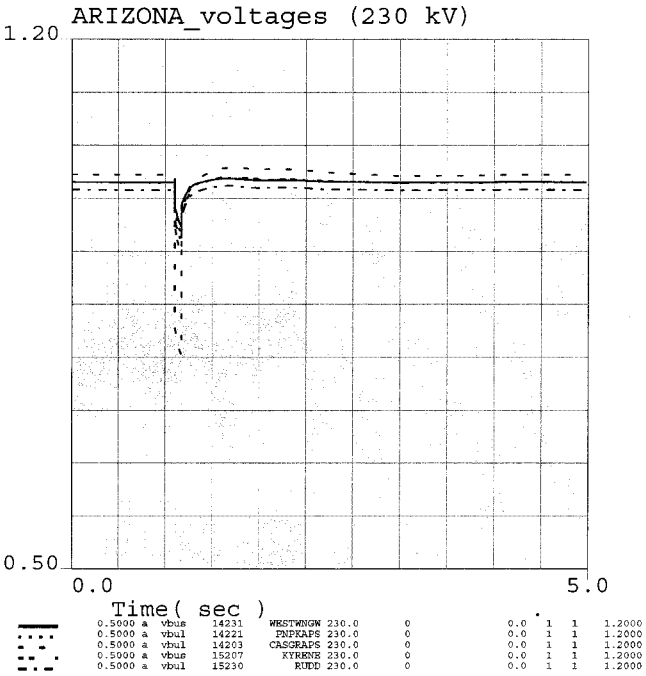

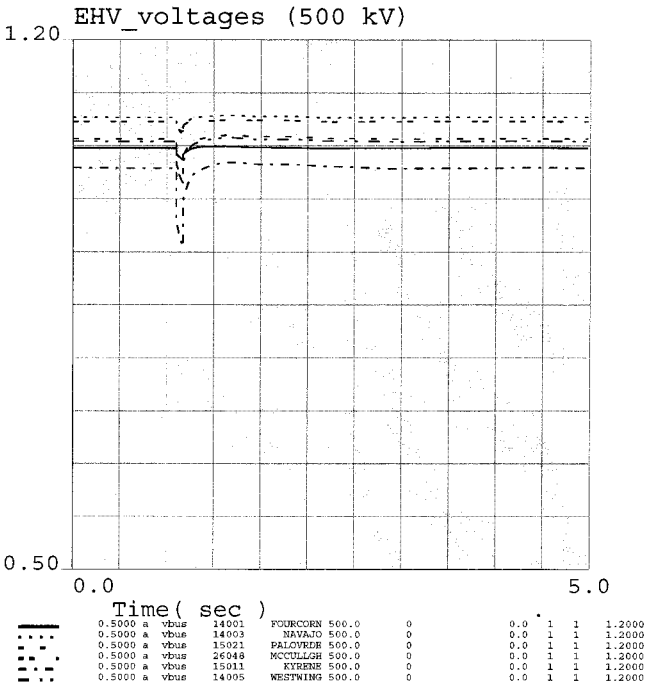

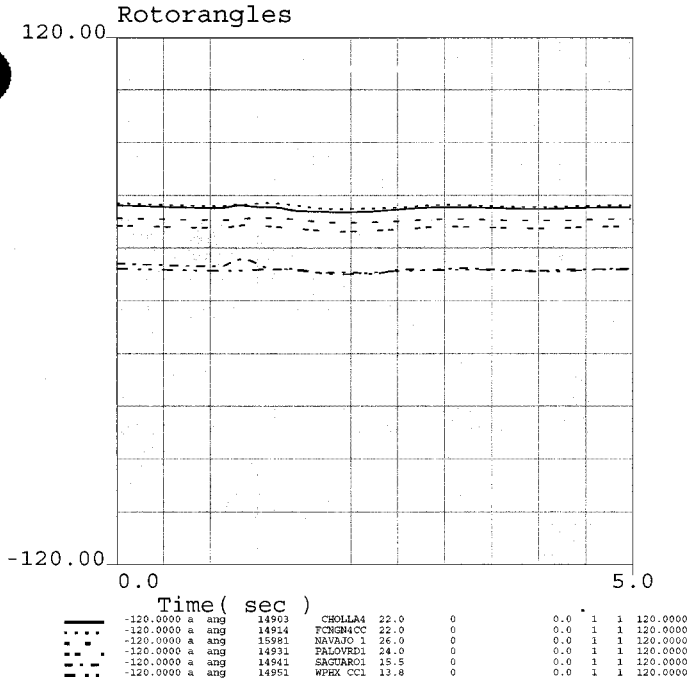

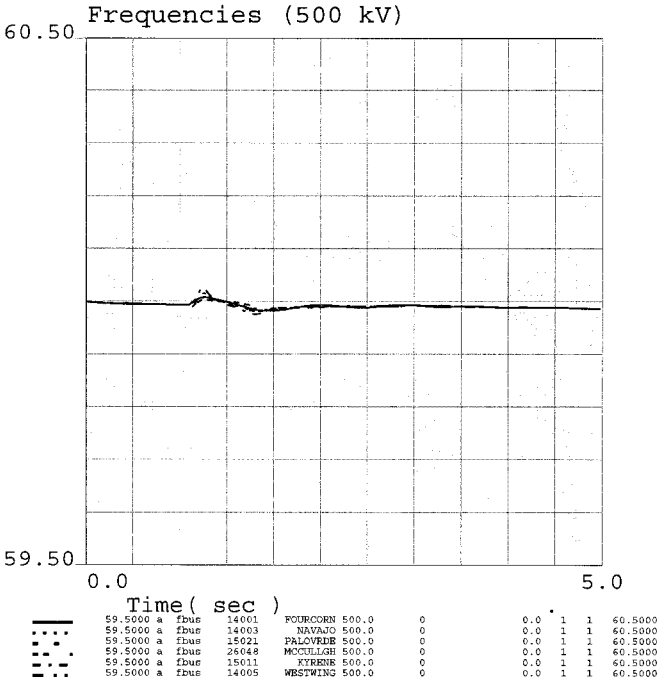

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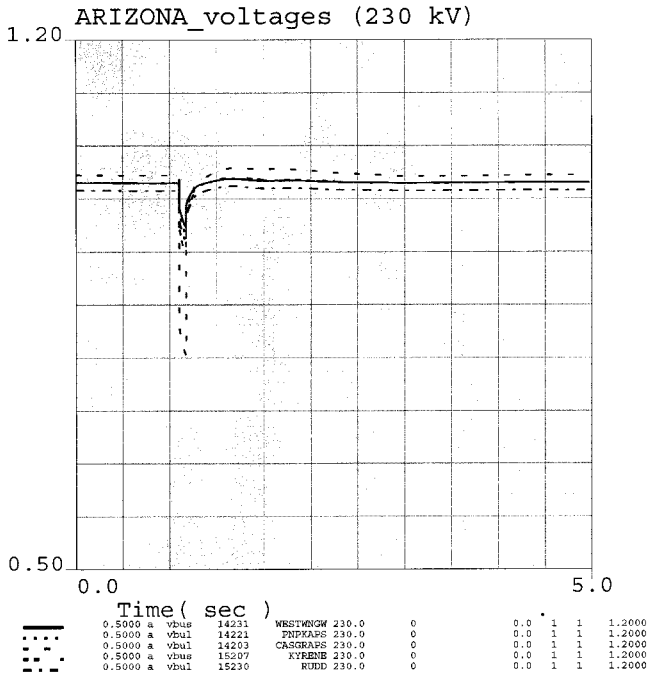

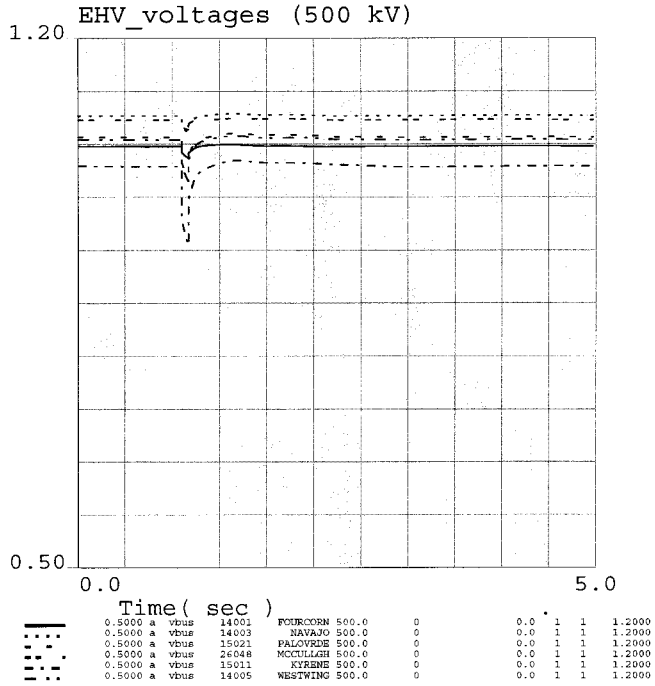

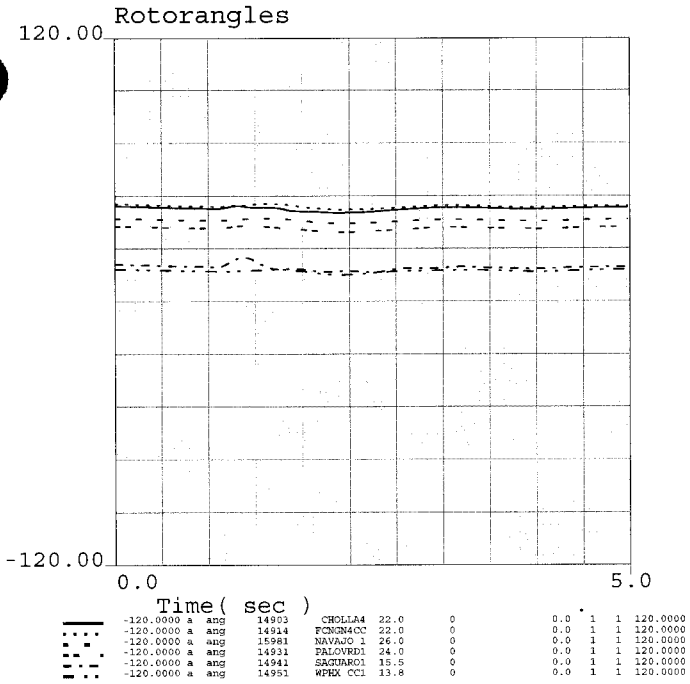

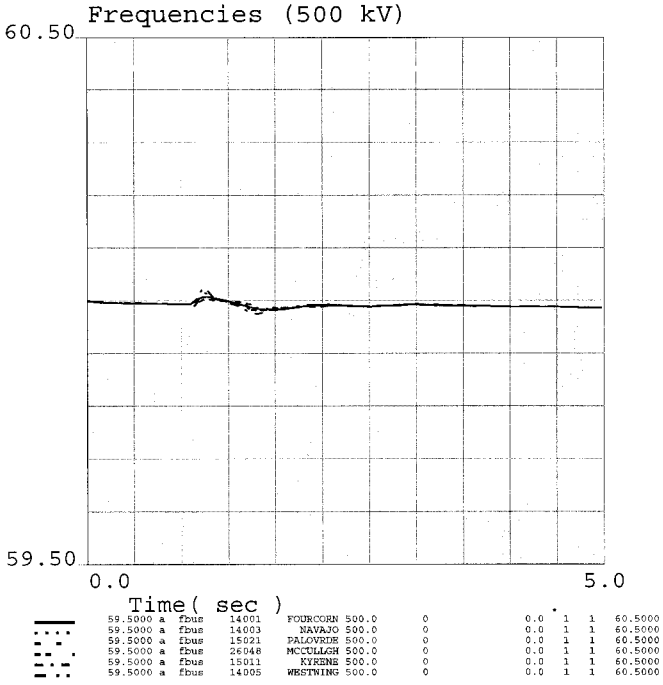

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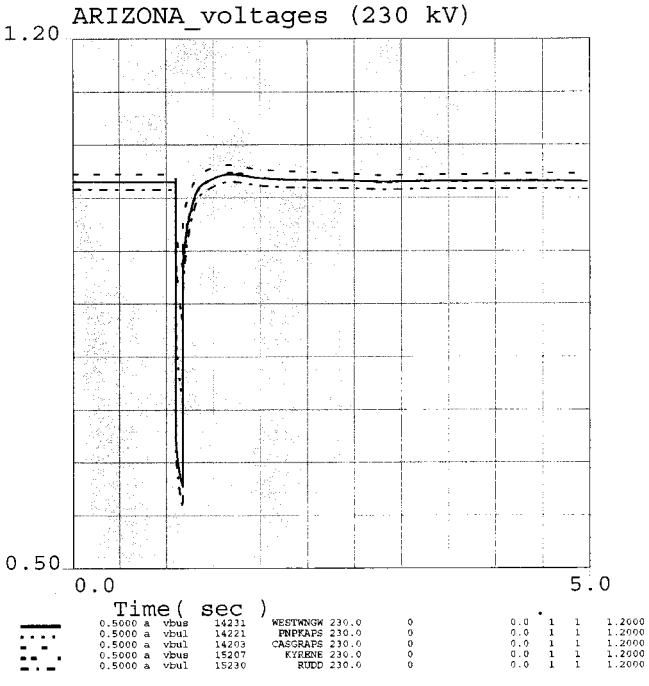

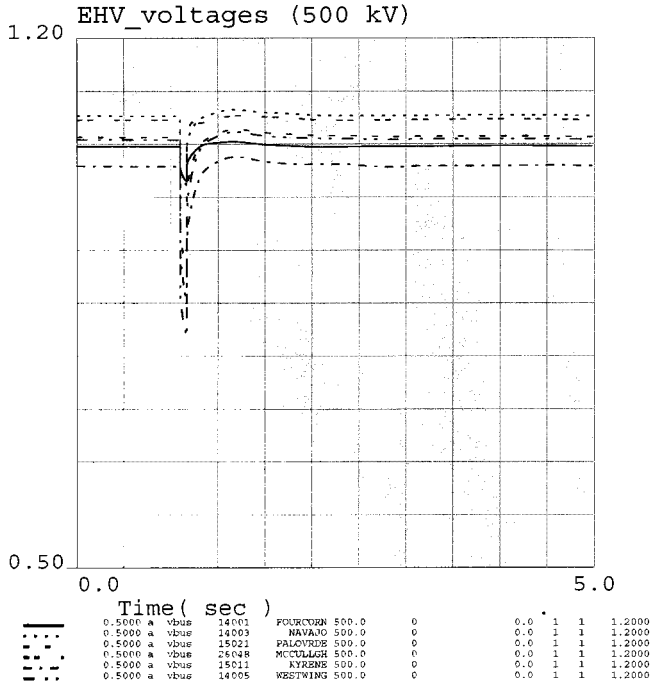

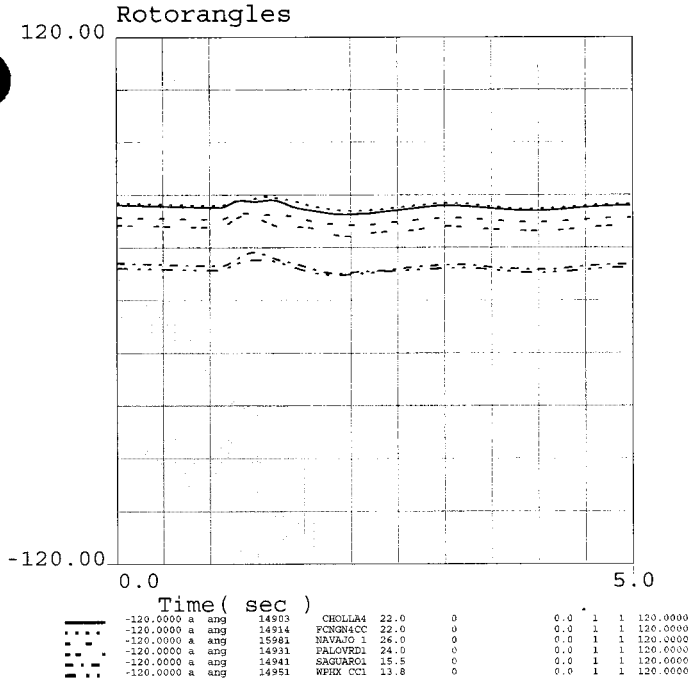

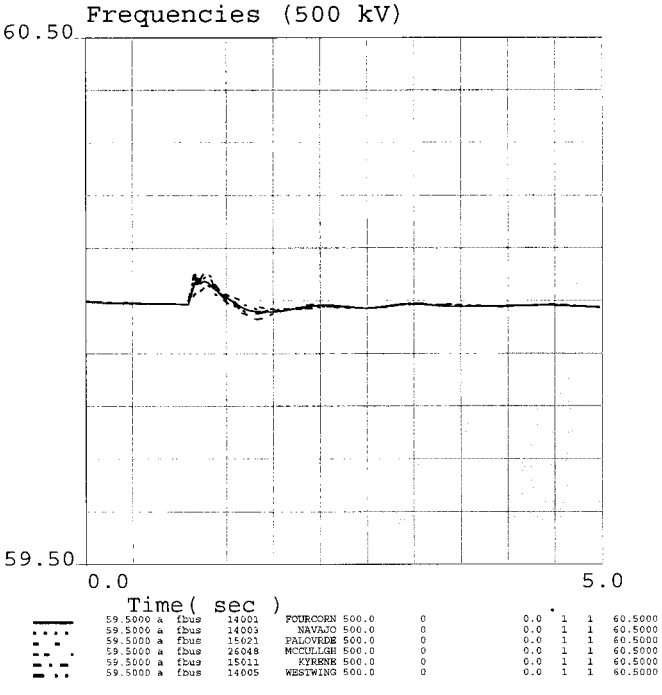

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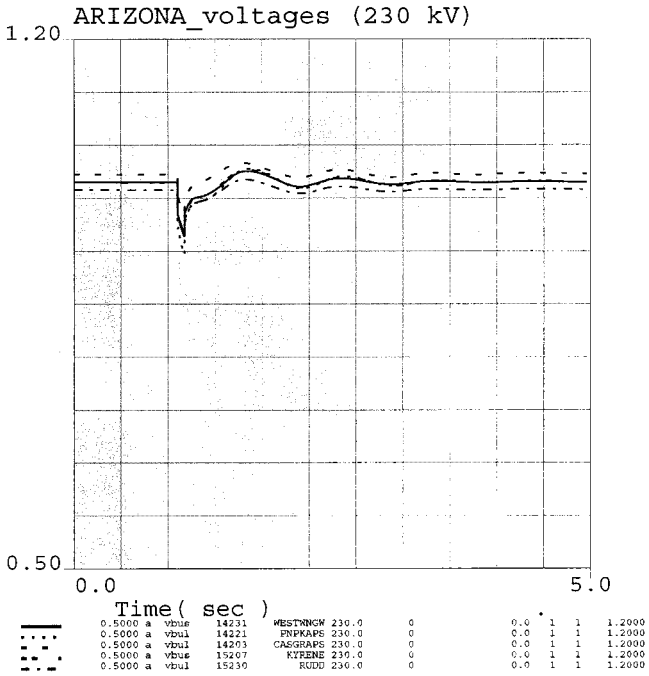
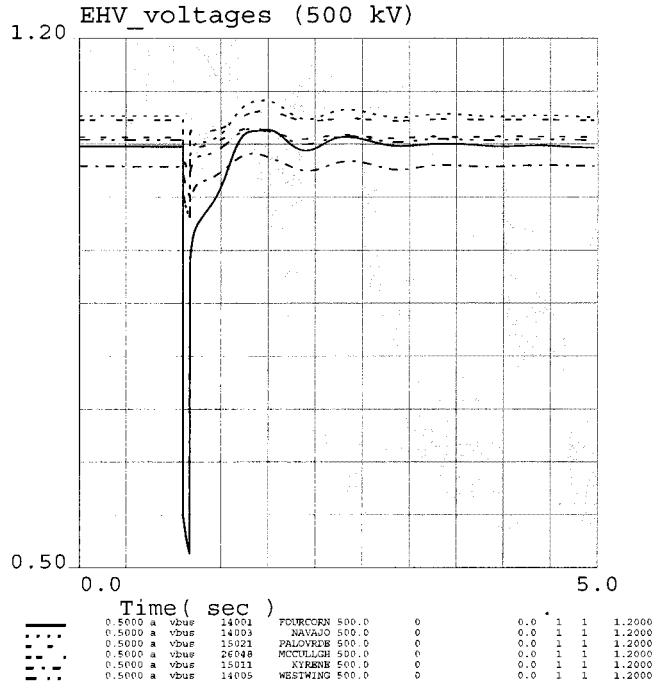
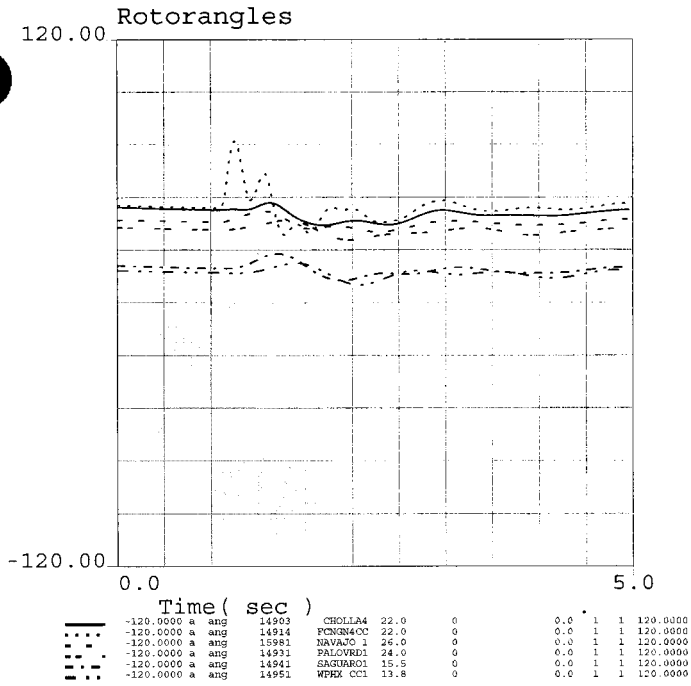
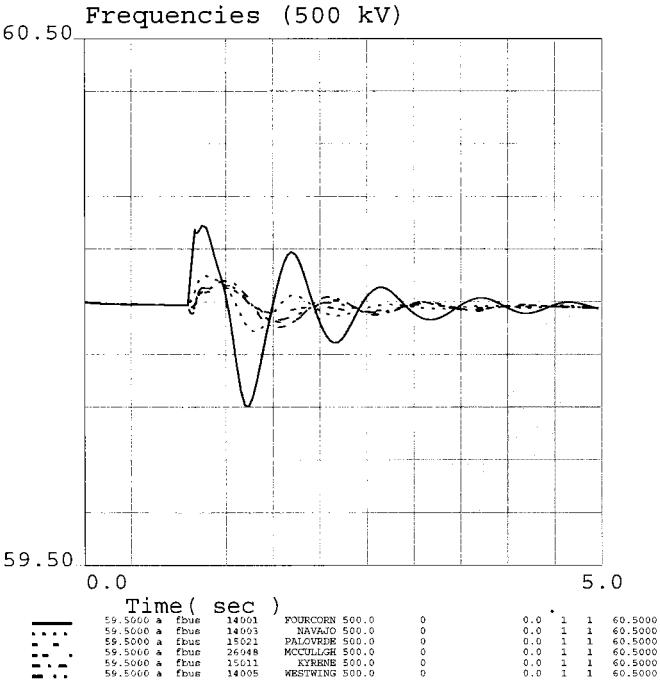
2009 APS Ten Year Plan
2018 Heavy Summer WECC/WestConnect Case









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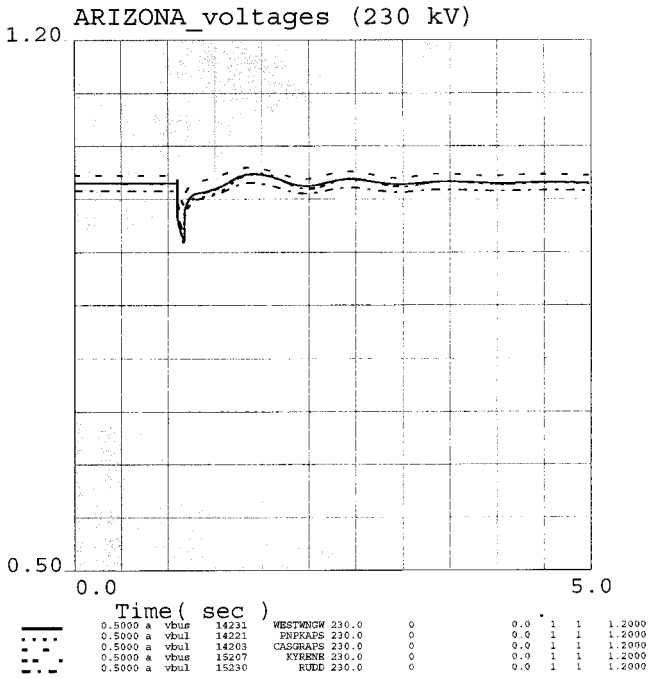

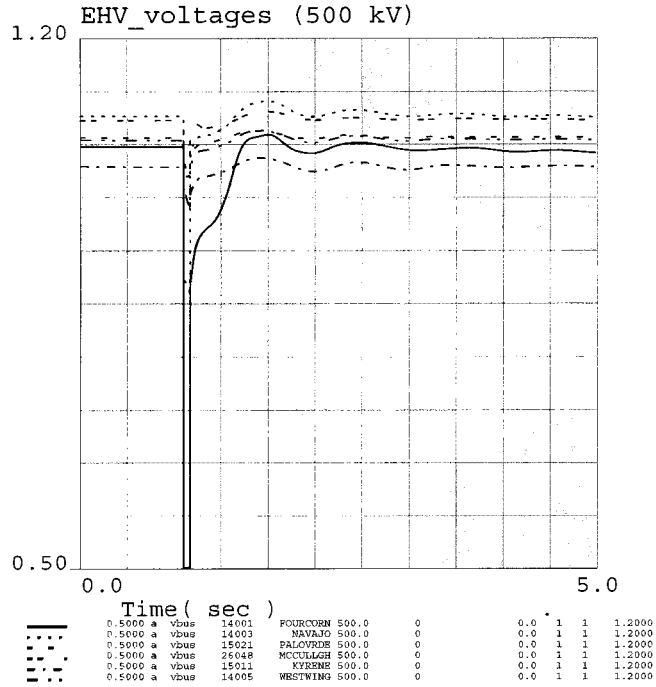

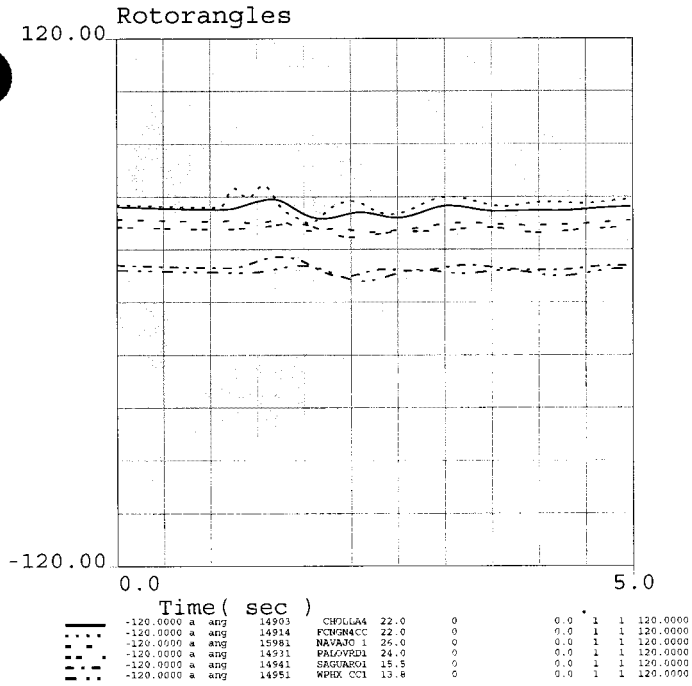

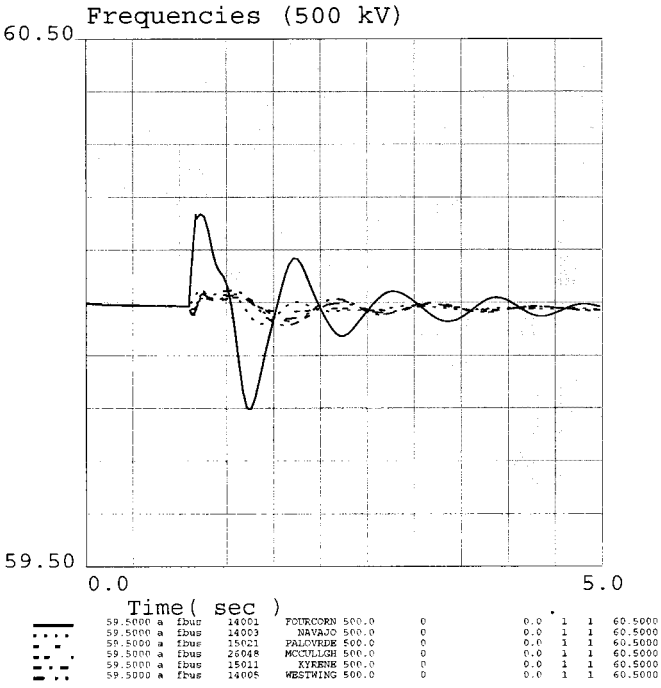

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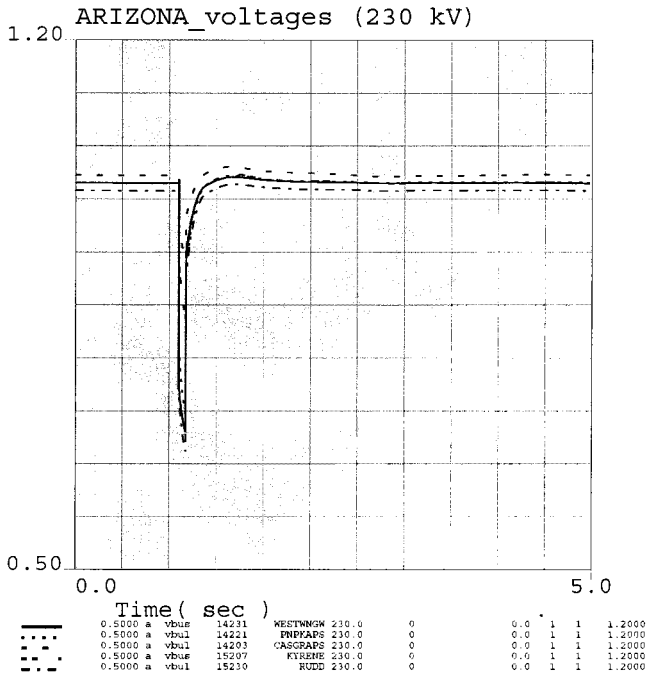

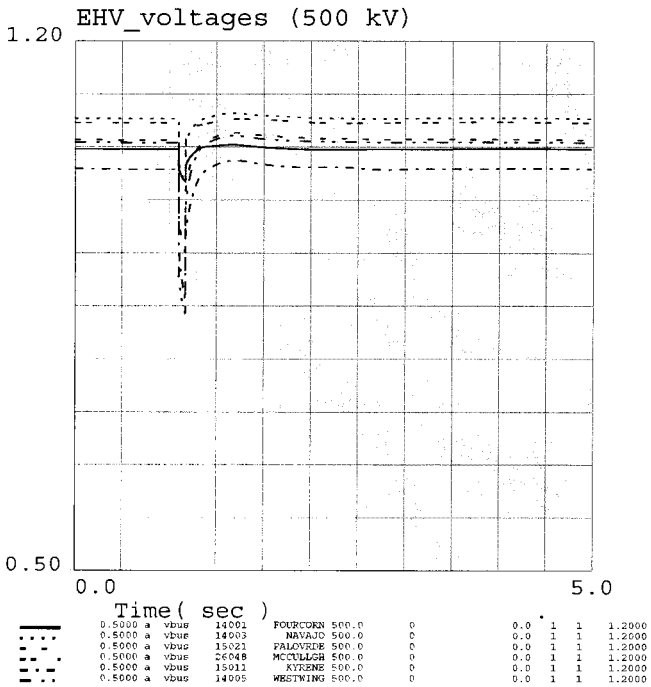

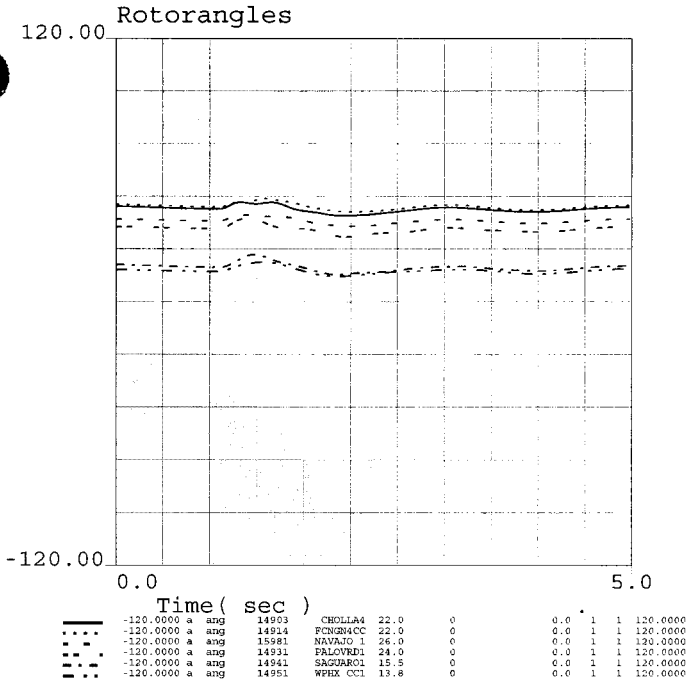

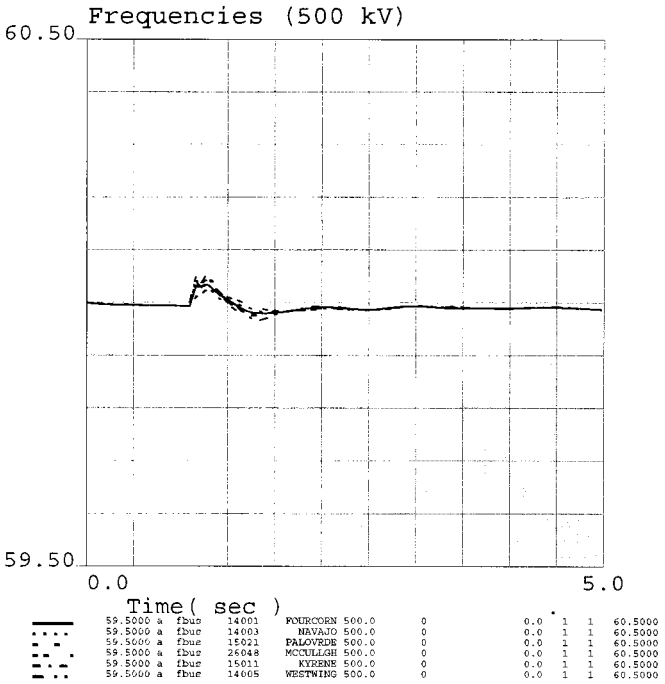

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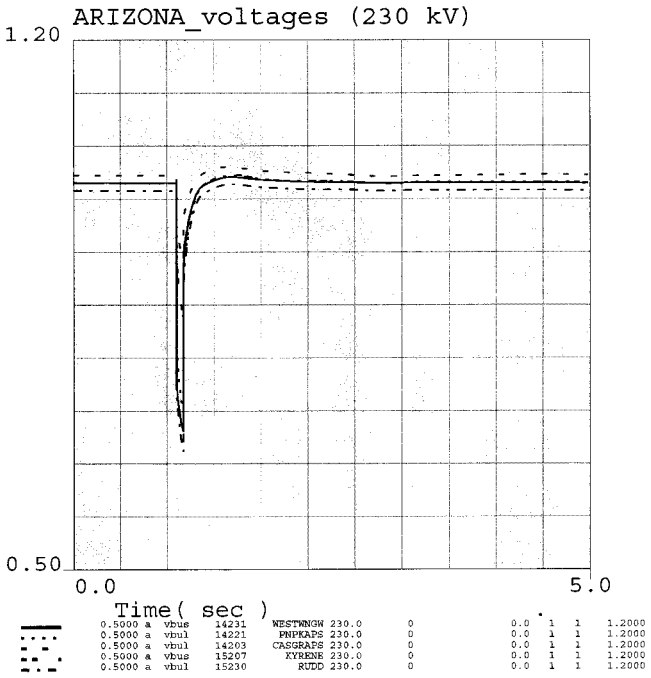

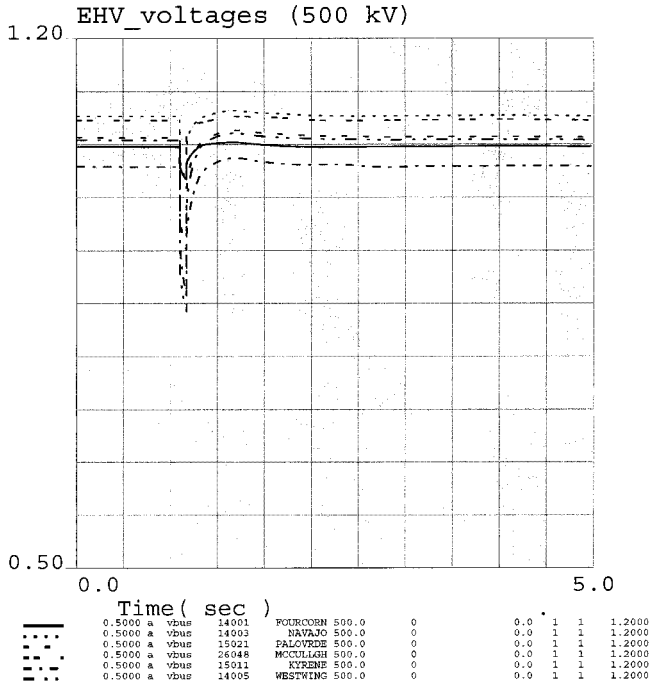

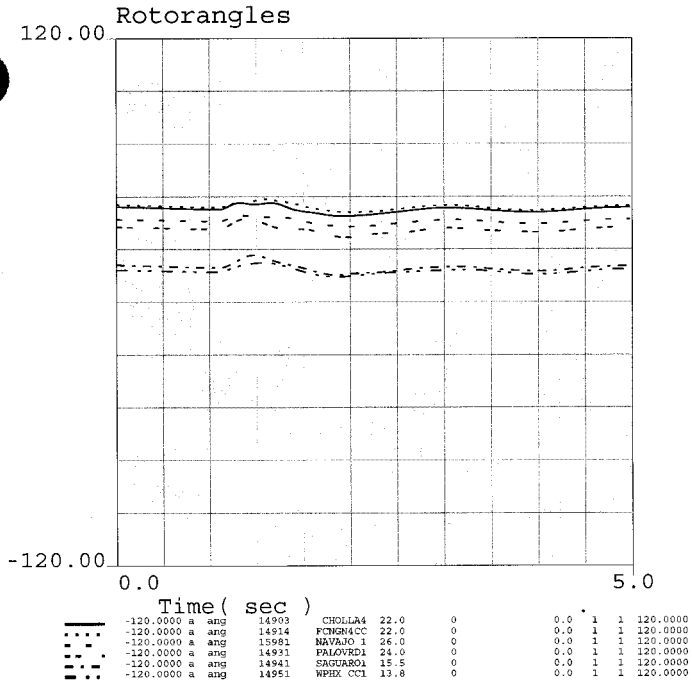

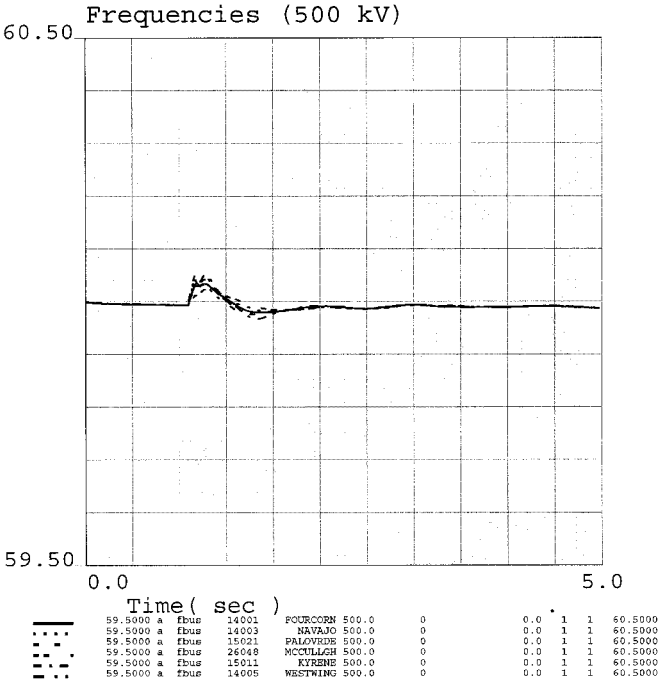

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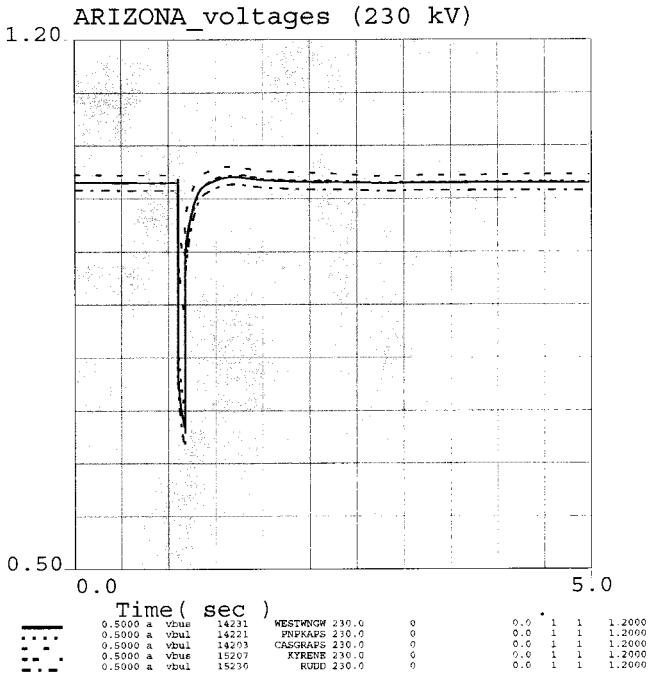

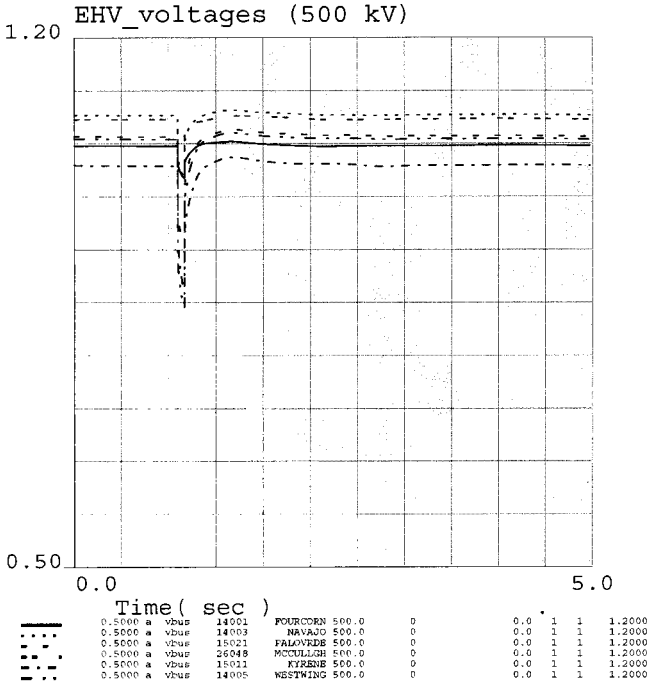

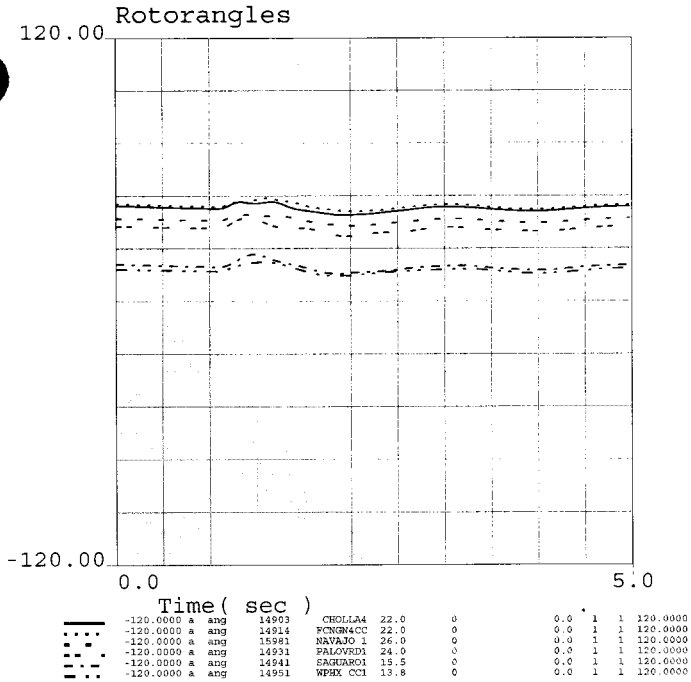

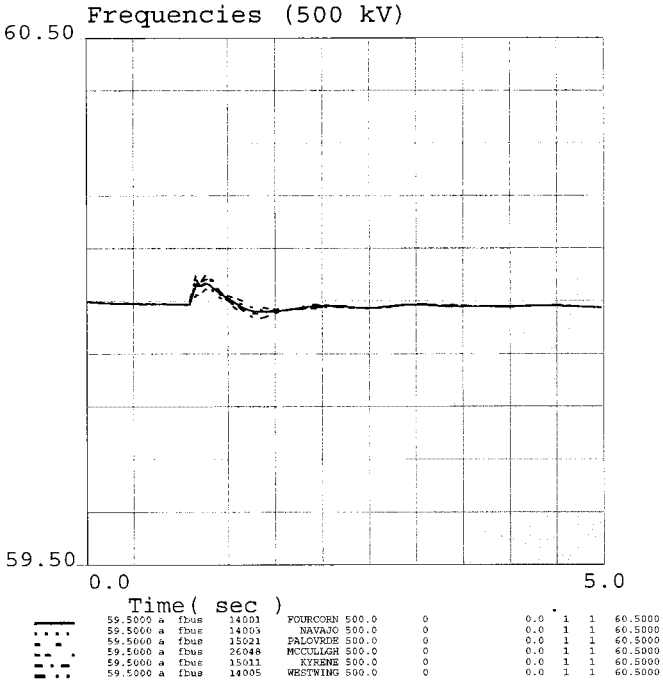

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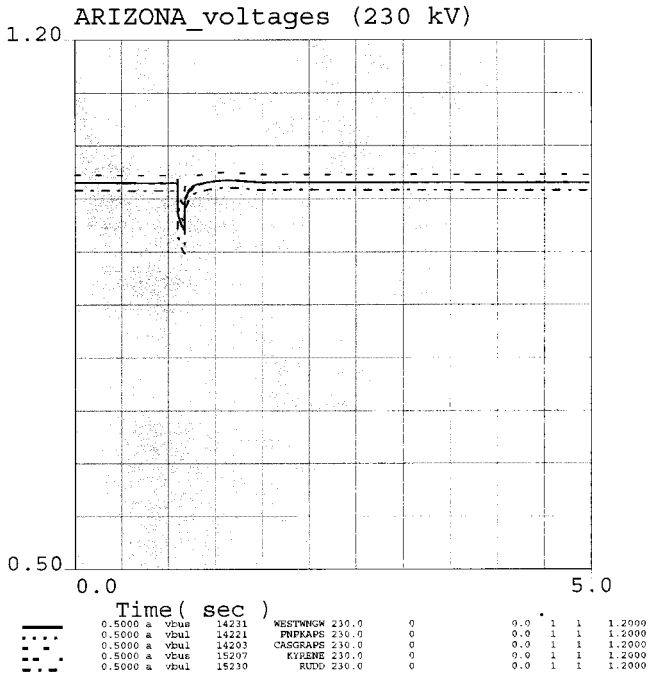

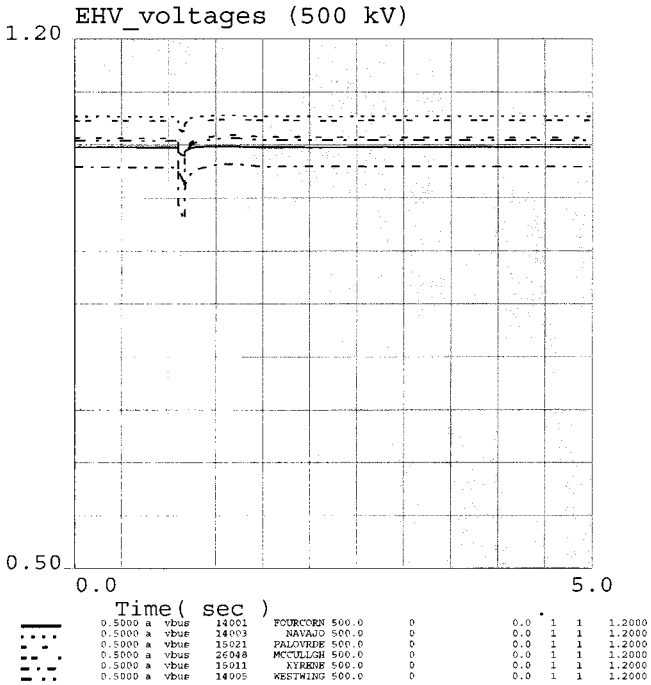

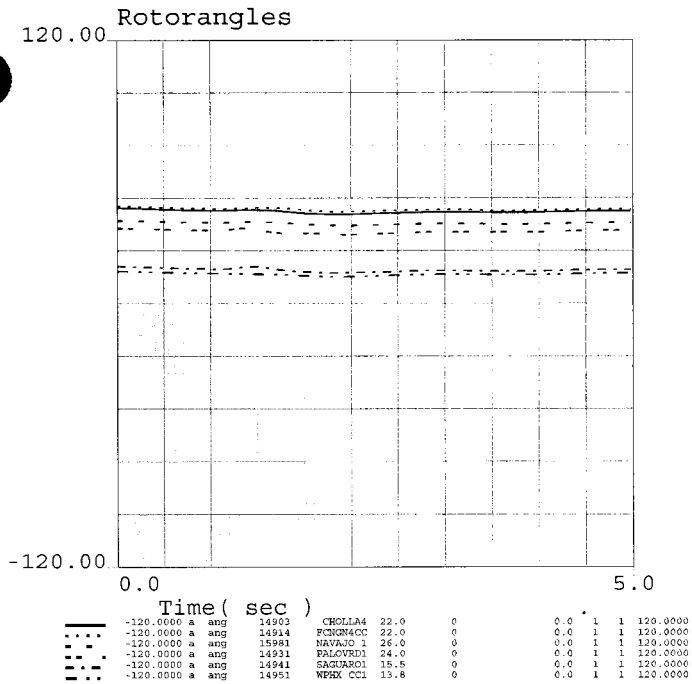

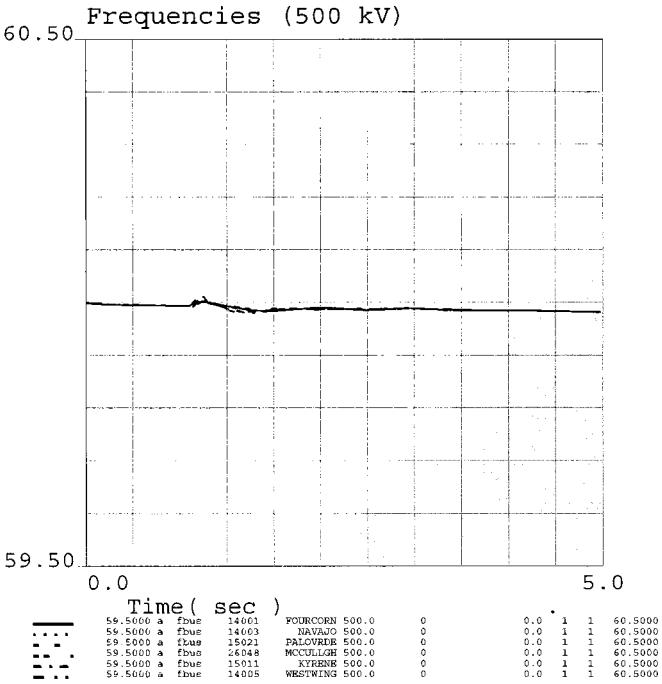

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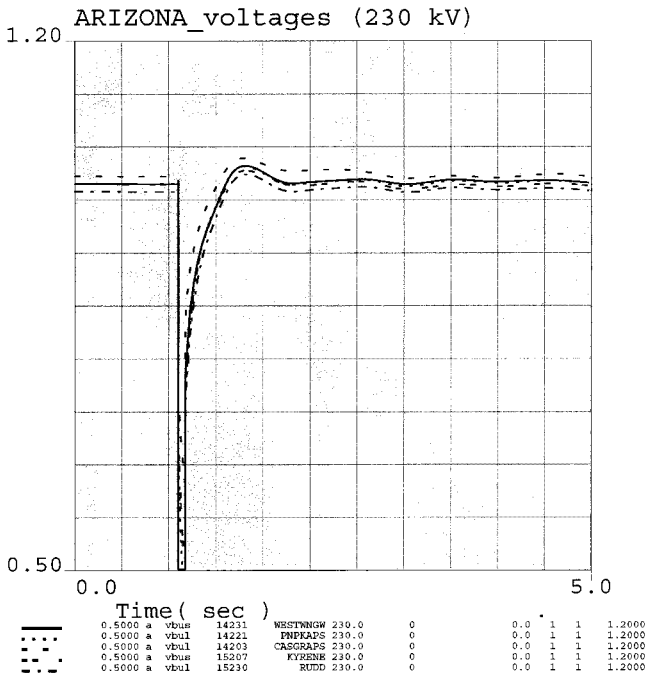

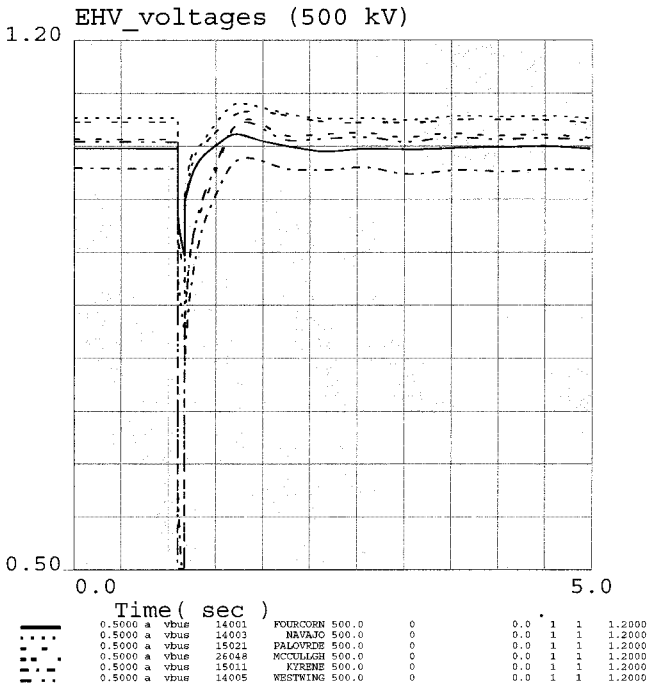

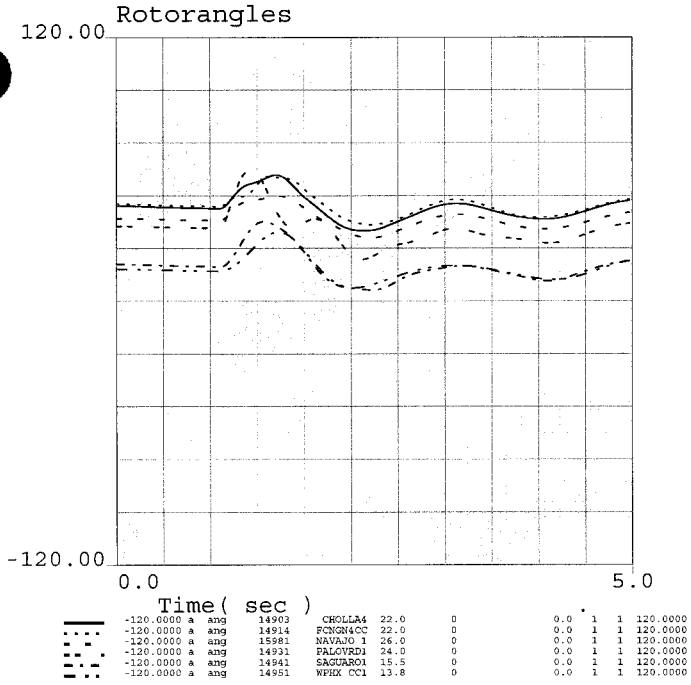

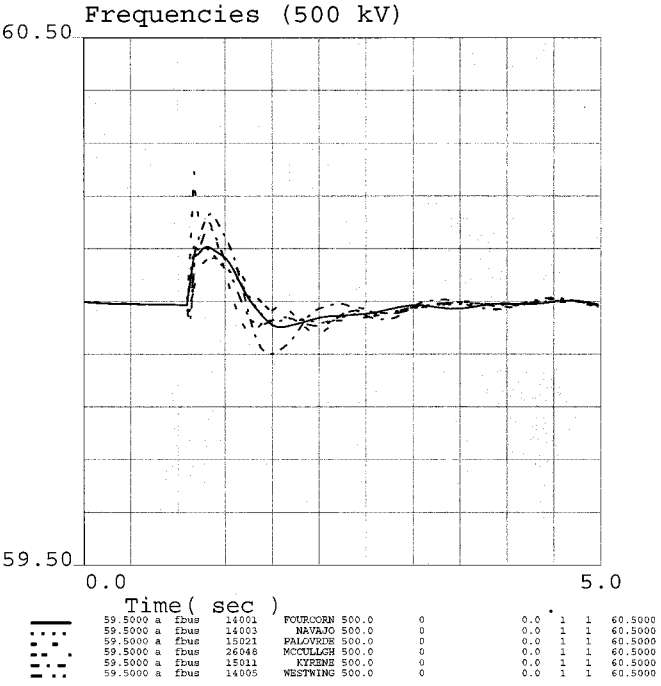

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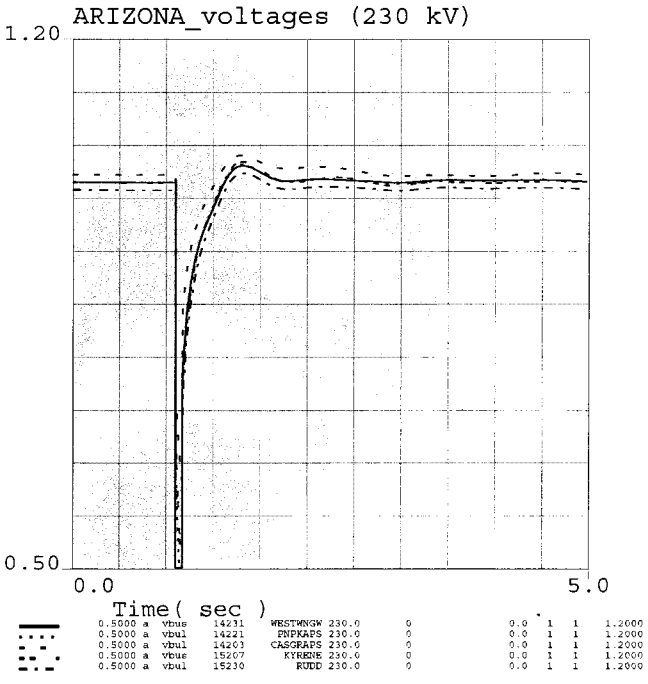

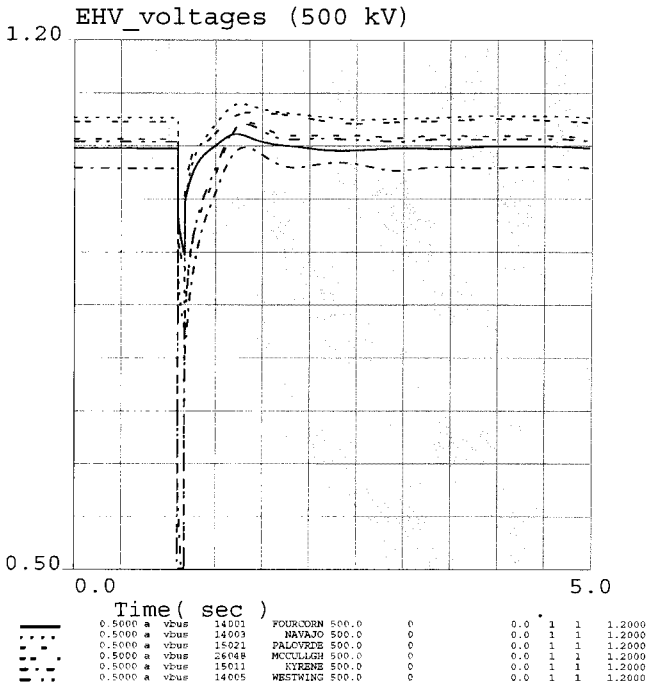

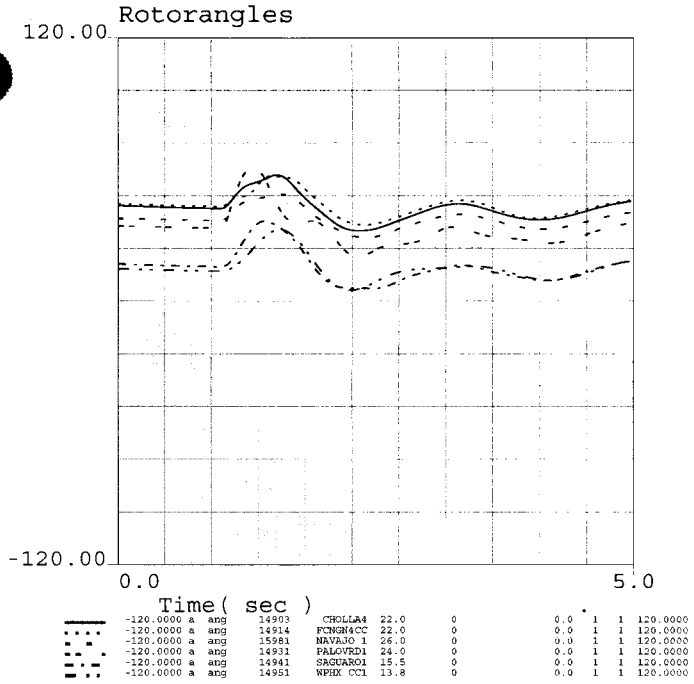

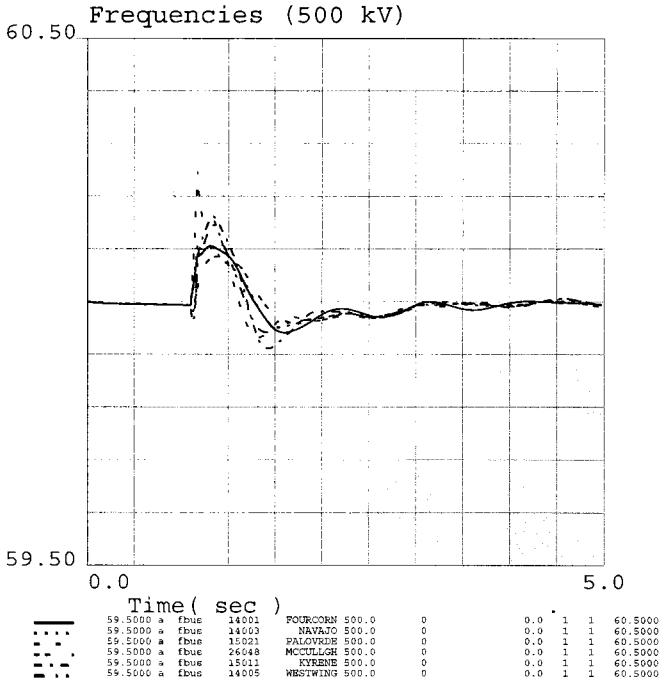

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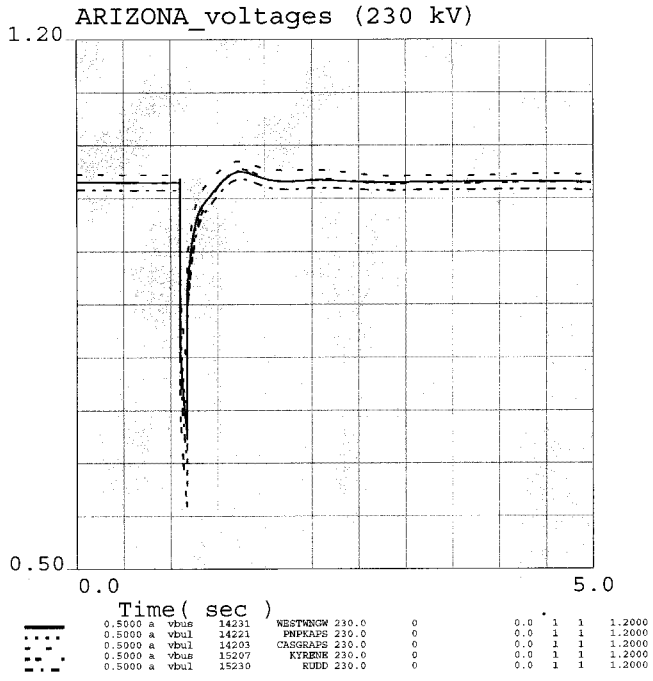

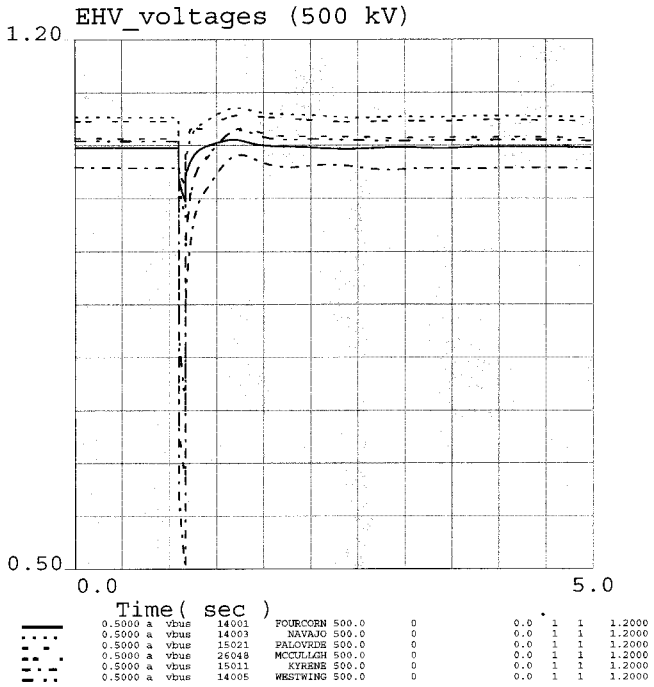

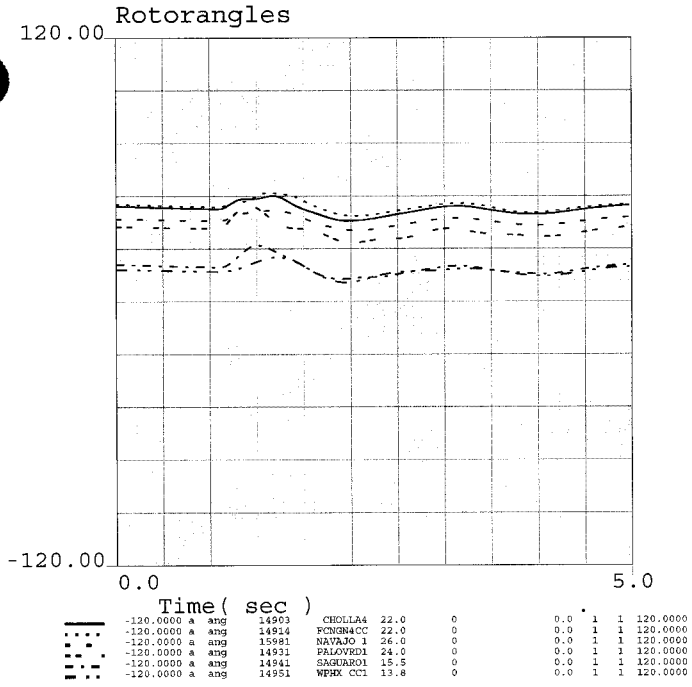

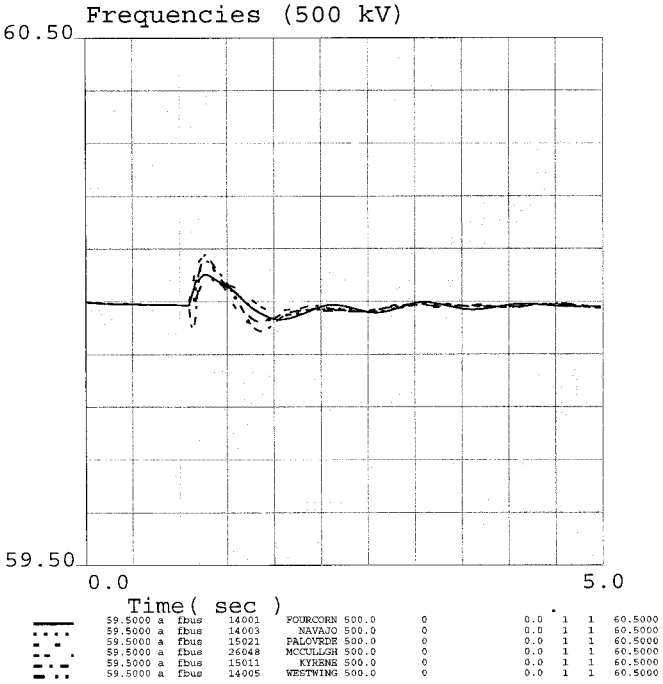

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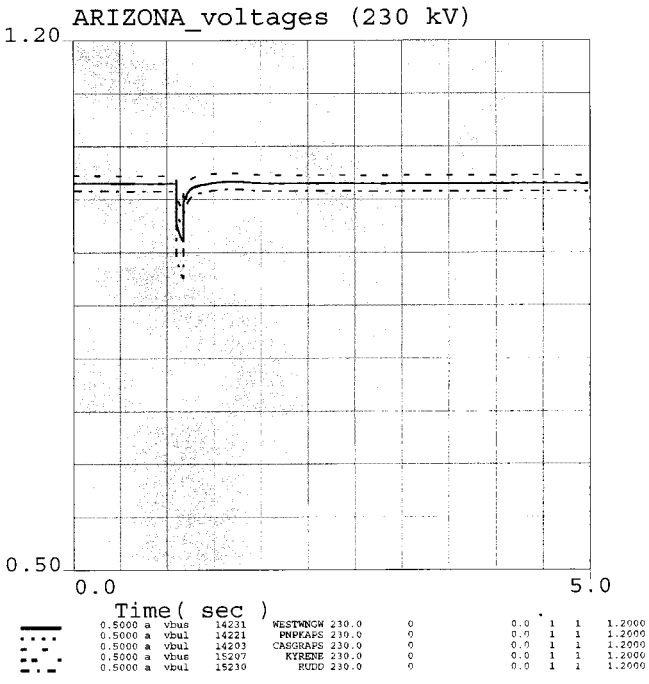

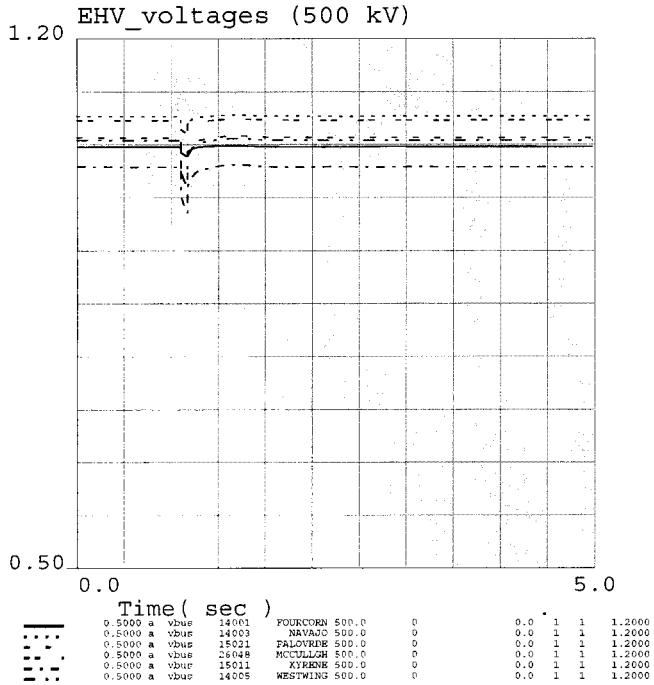

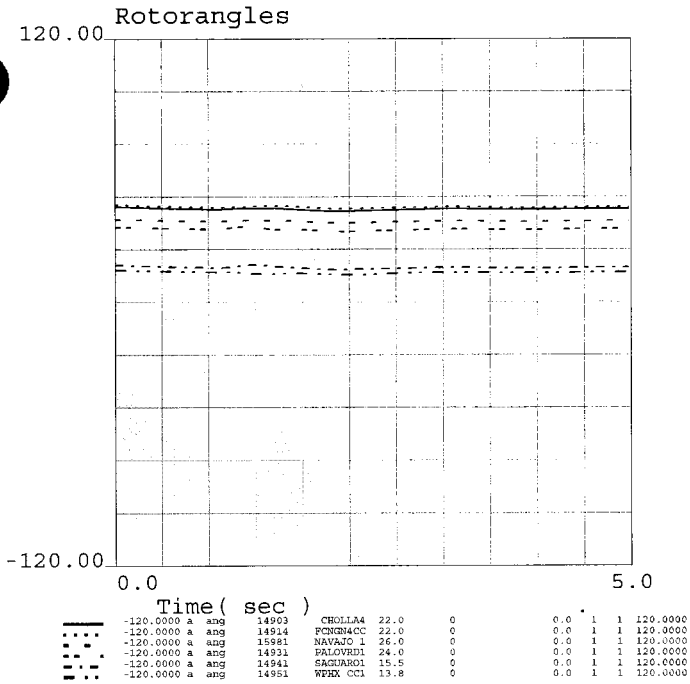

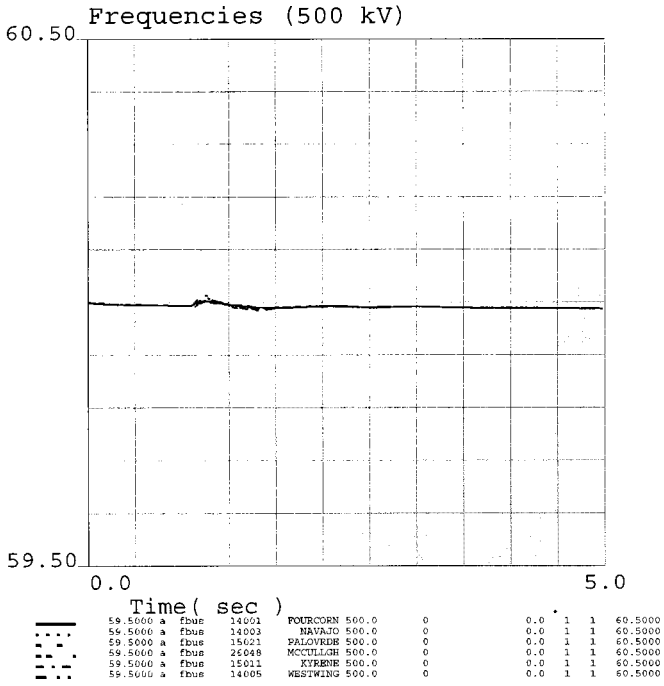

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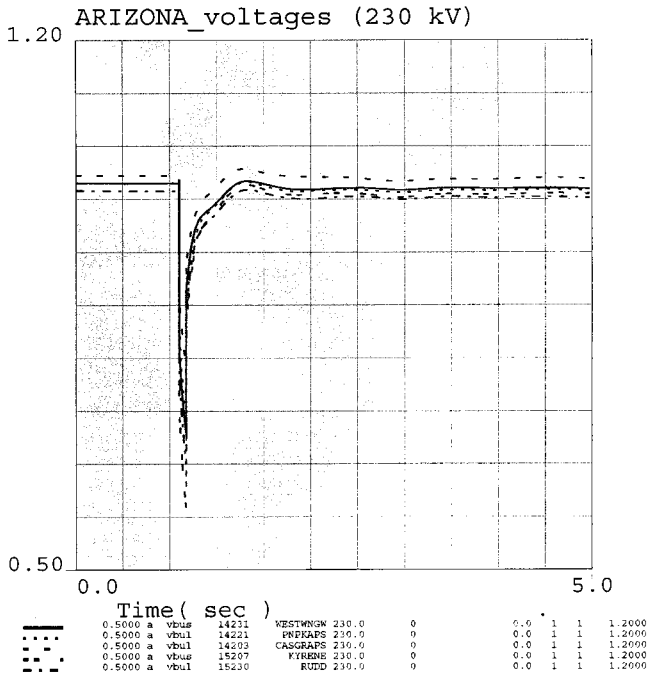

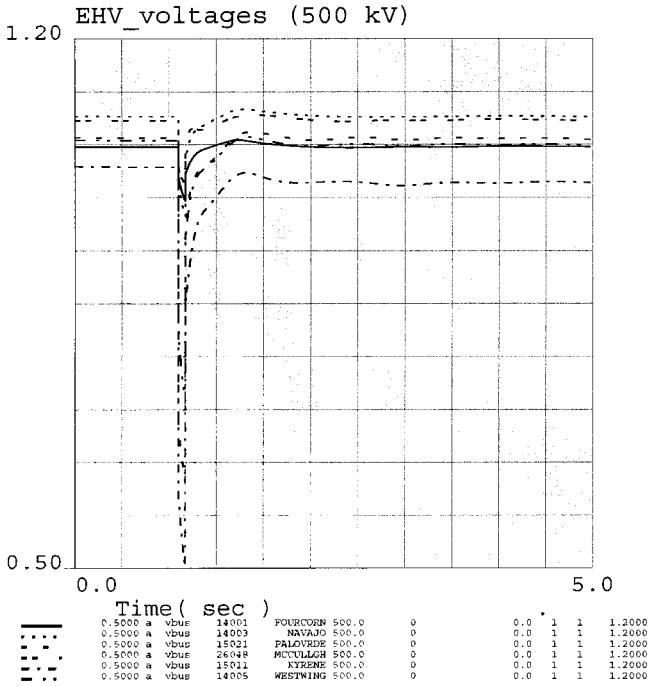

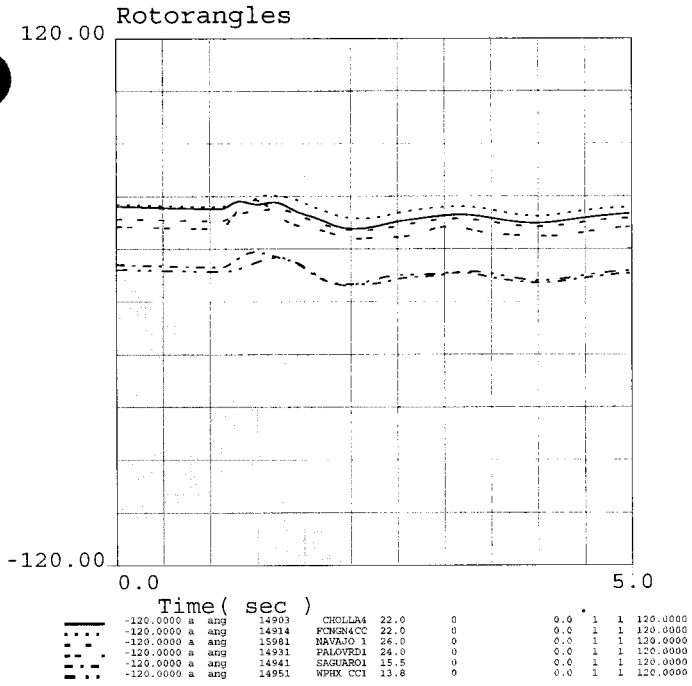

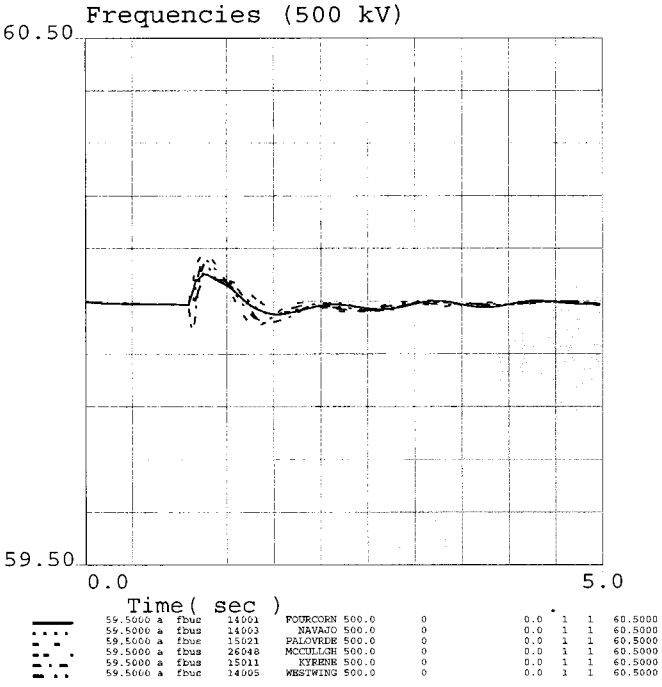

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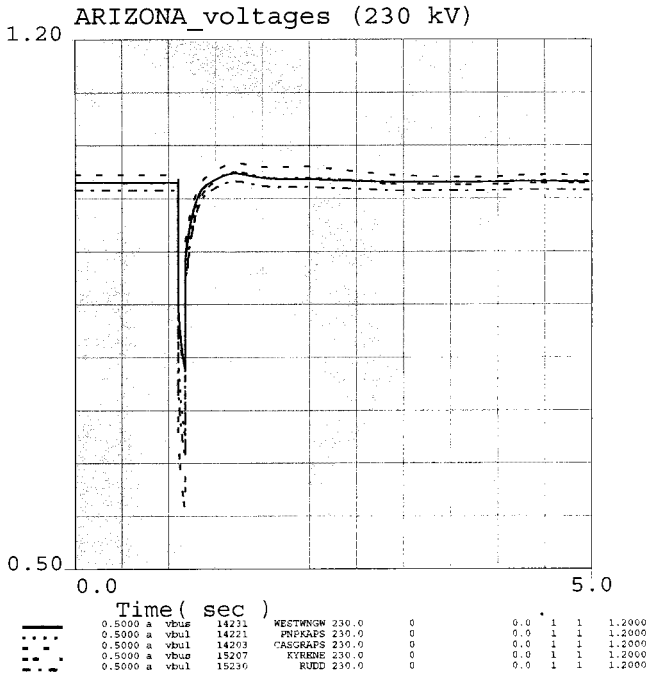

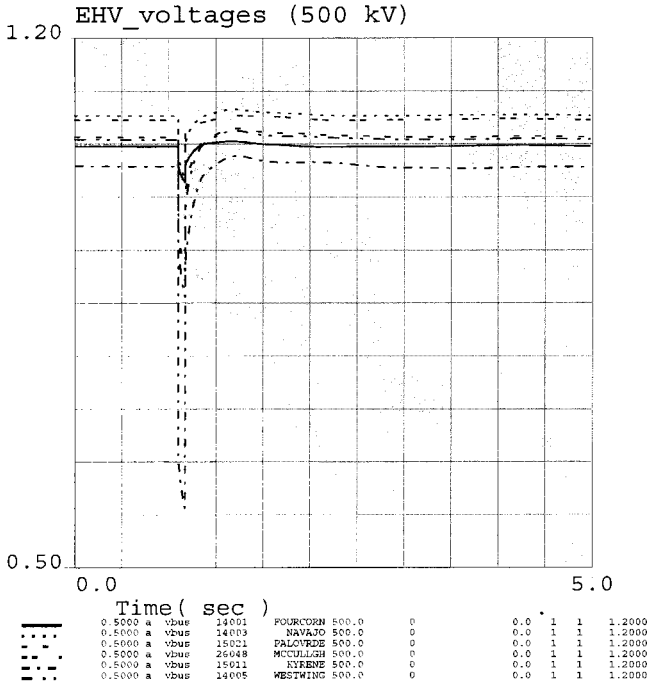

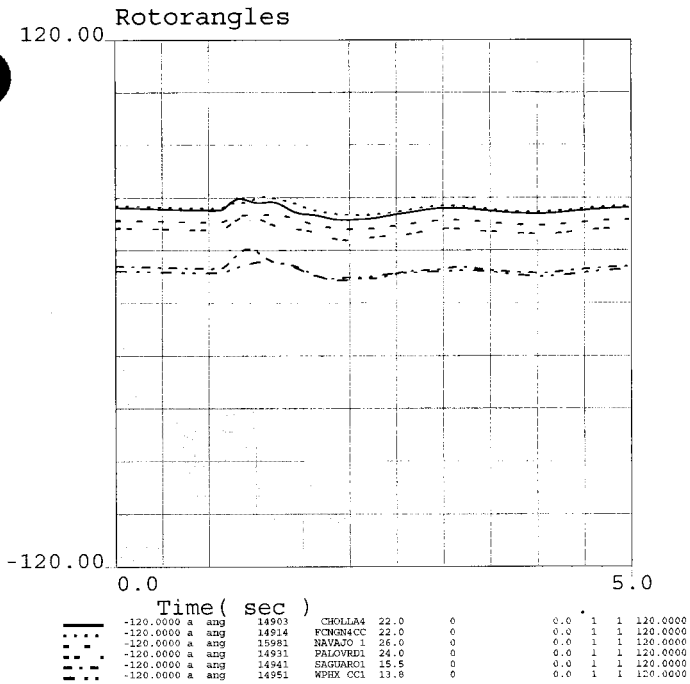

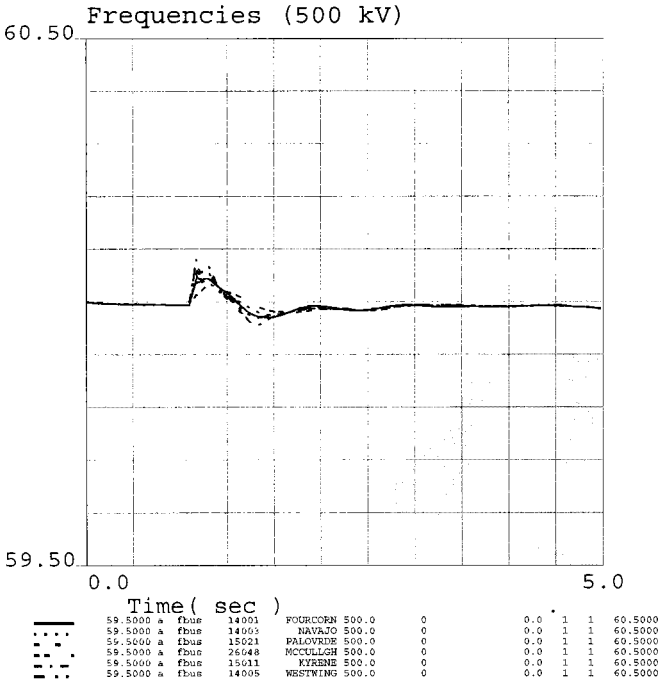

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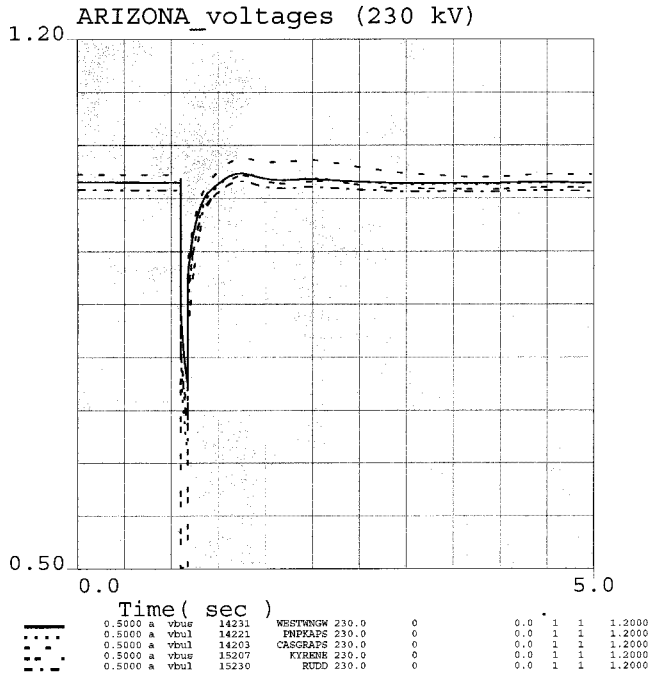

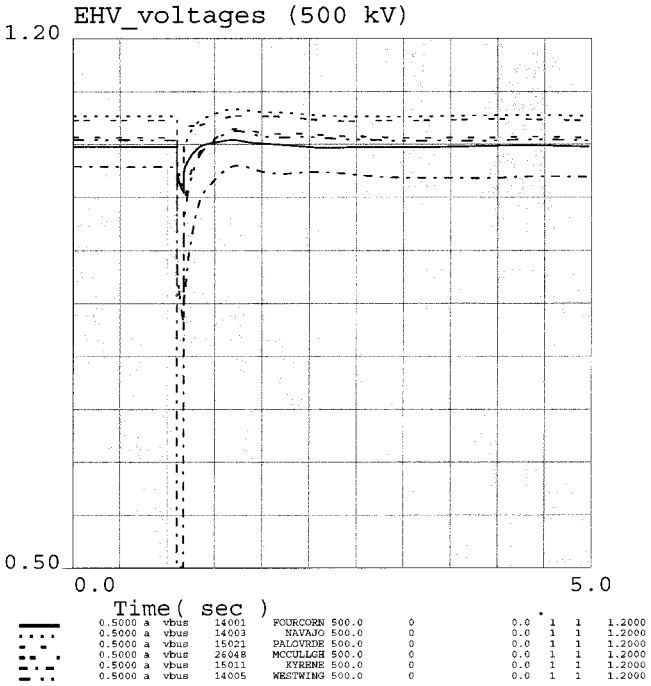

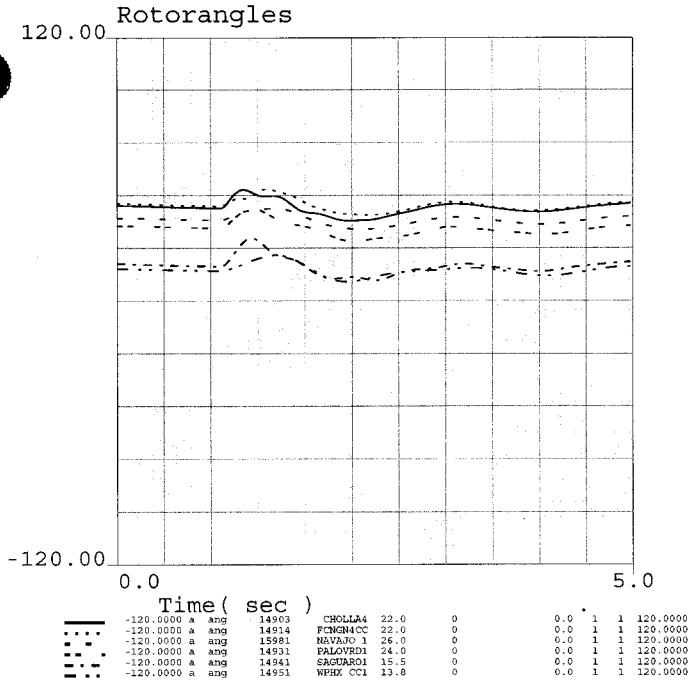

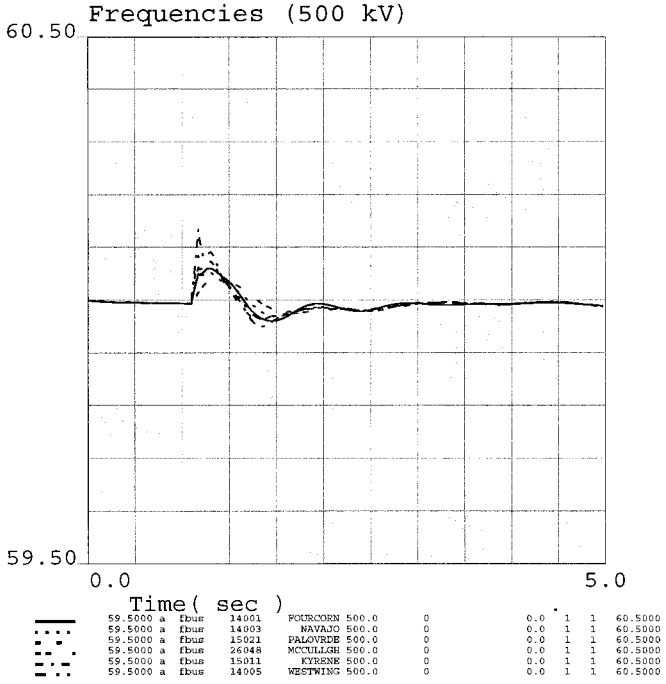

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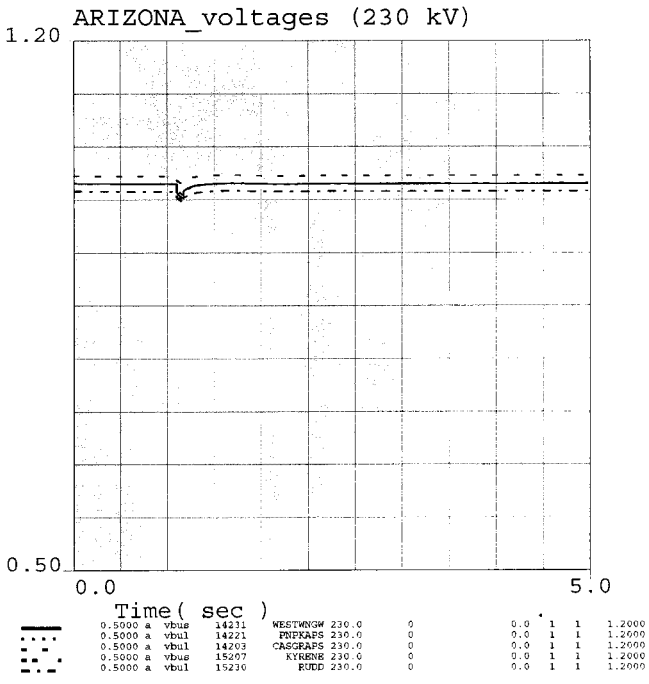

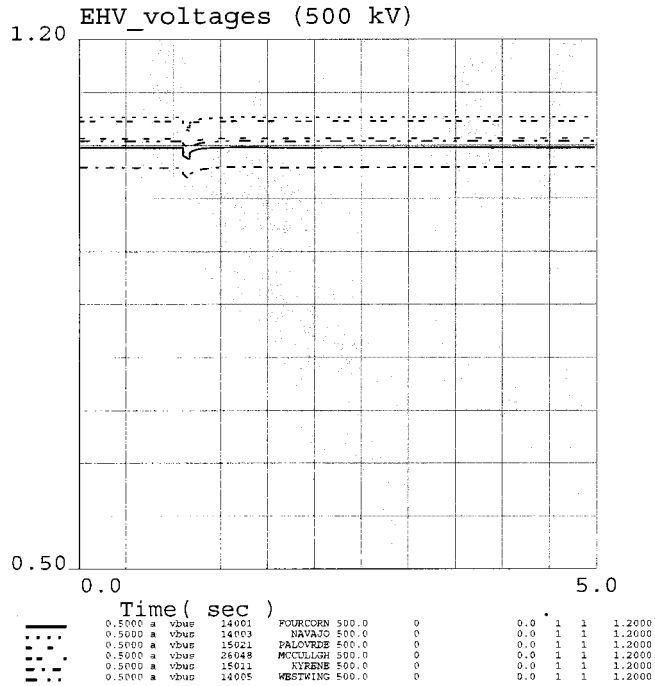

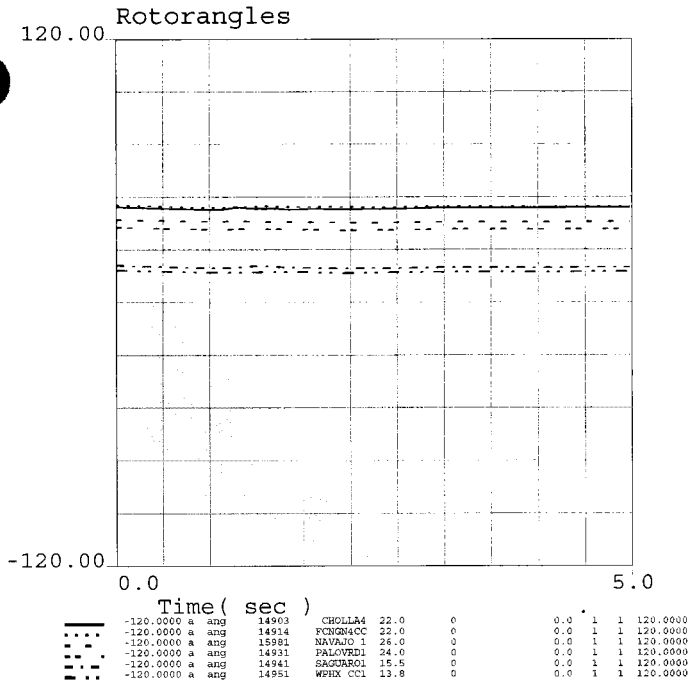

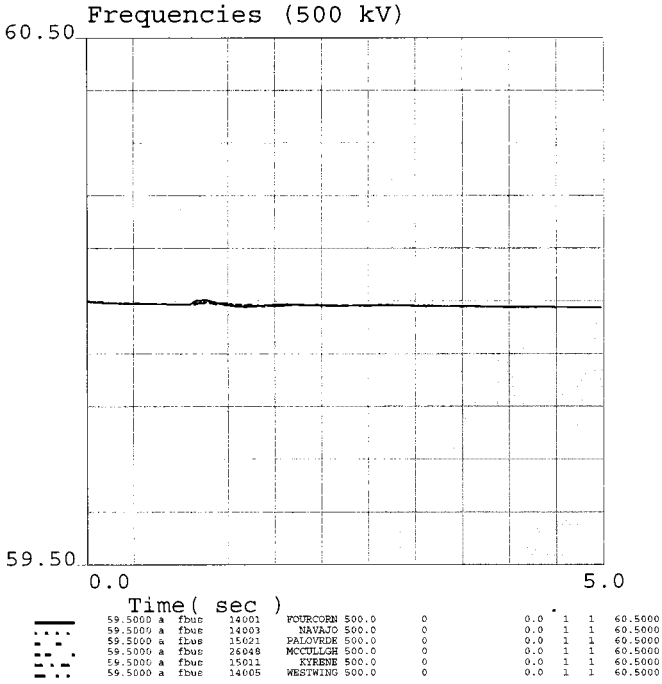

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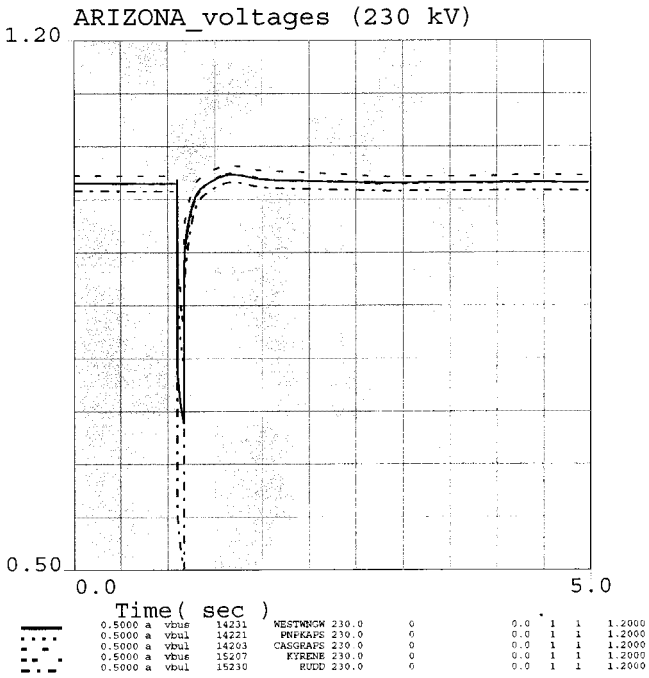

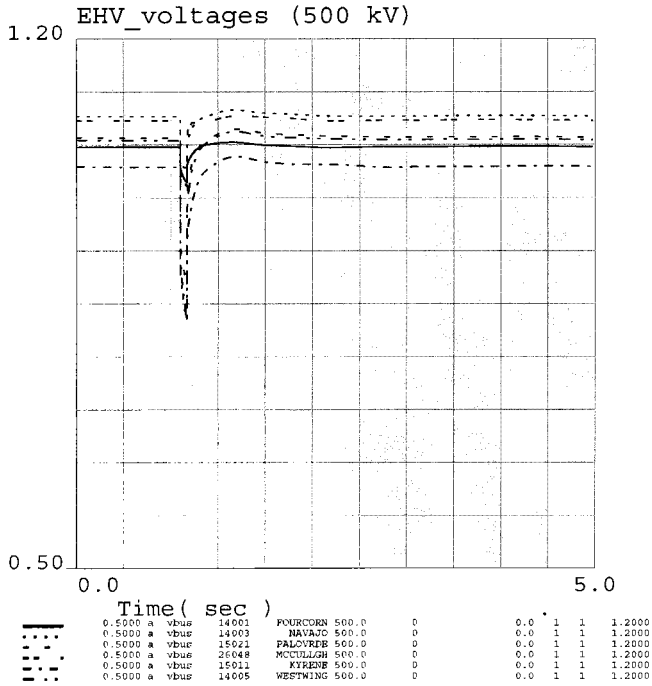

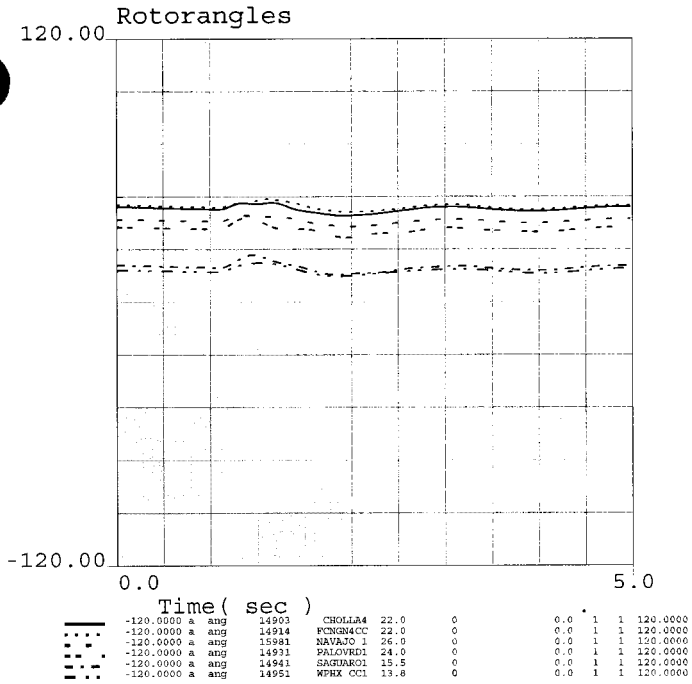

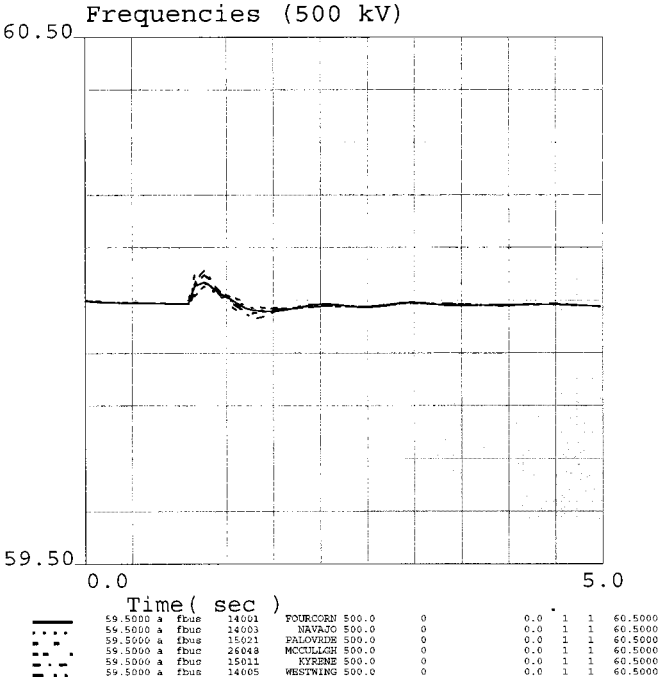

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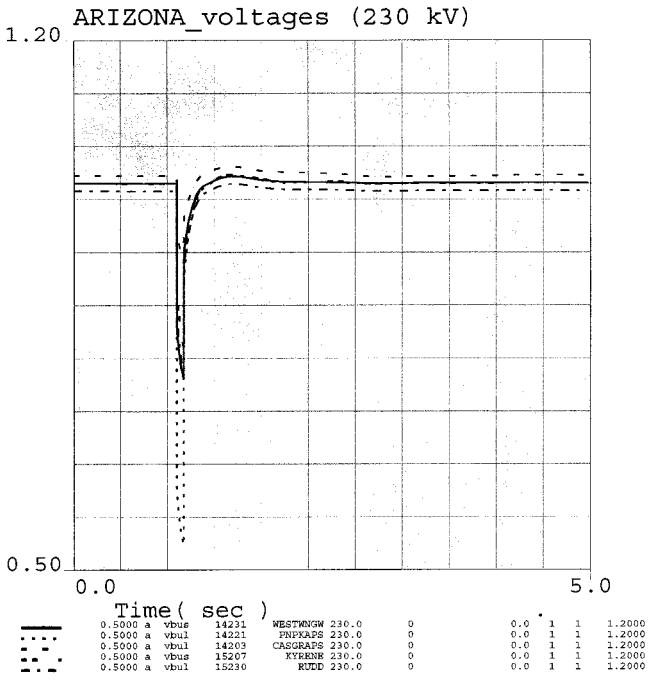

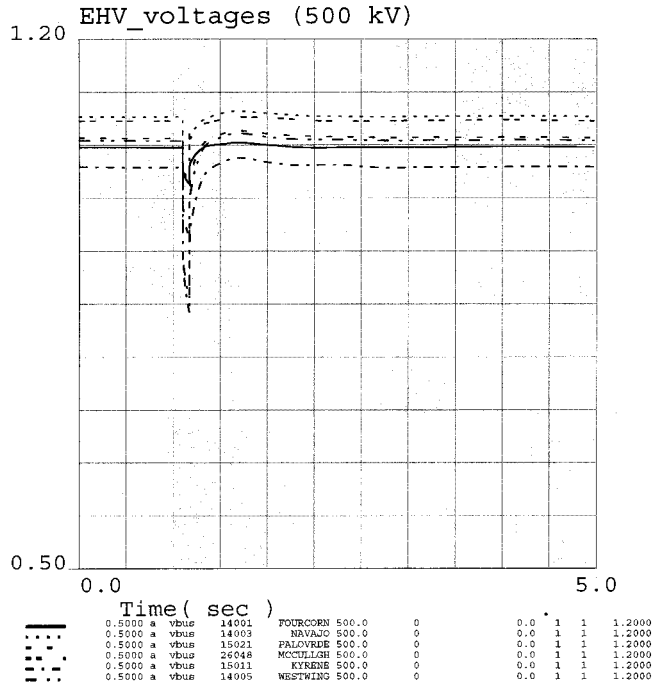

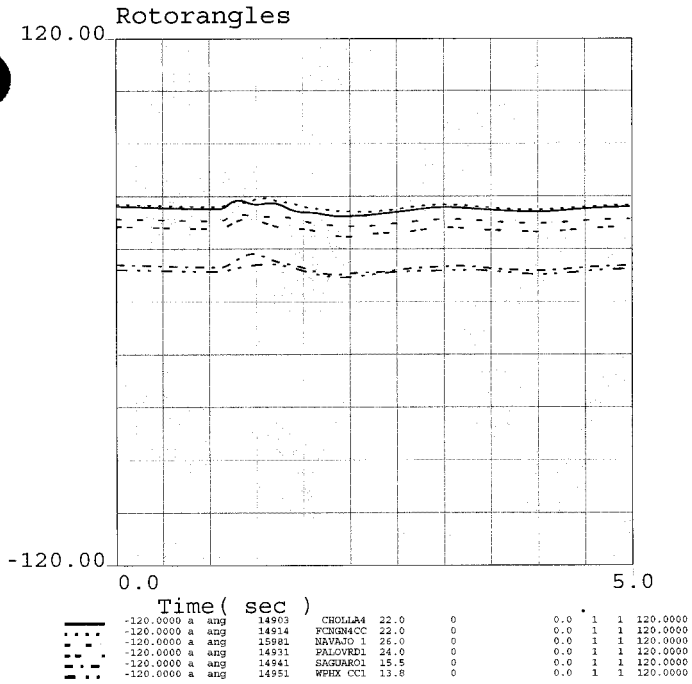

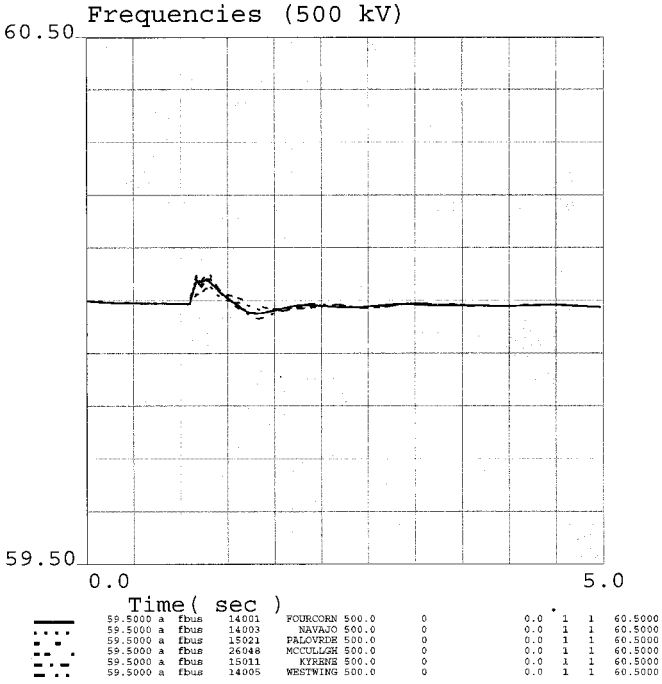

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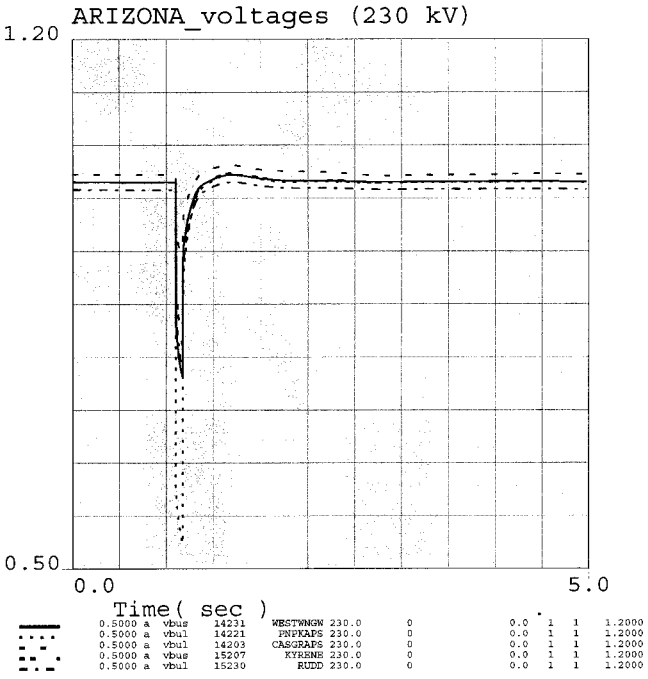

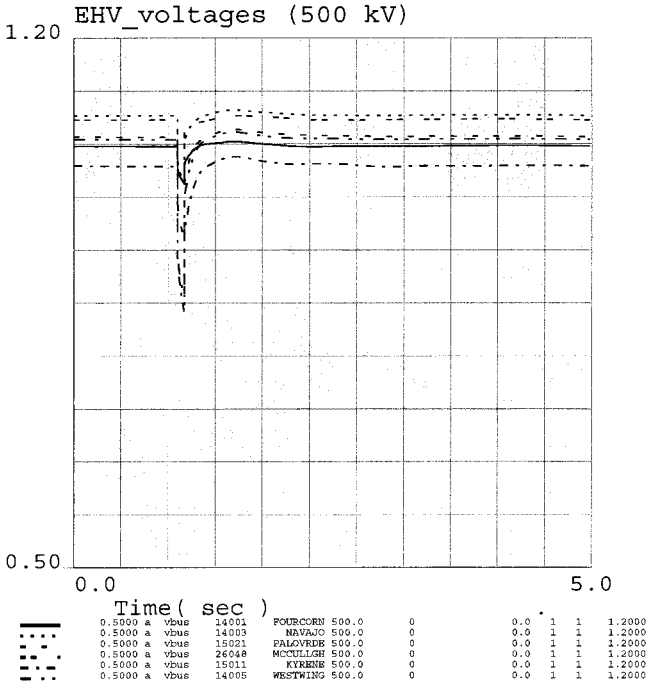

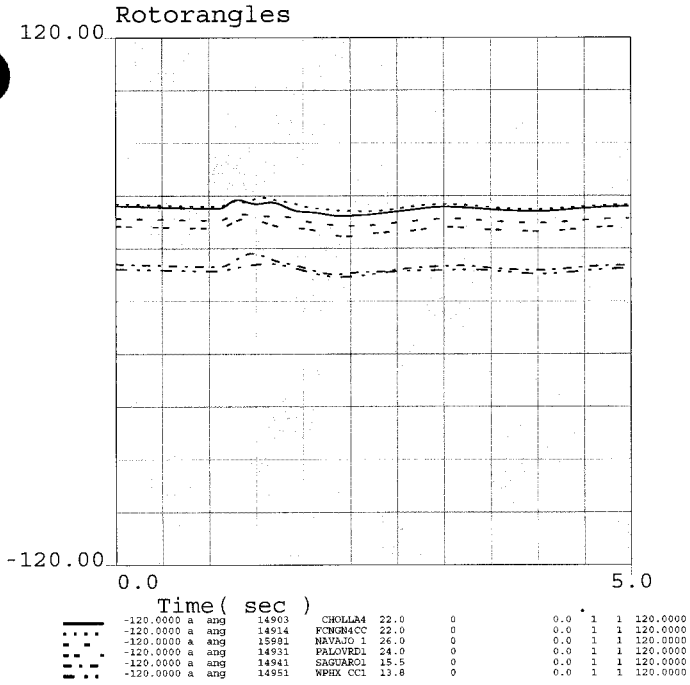

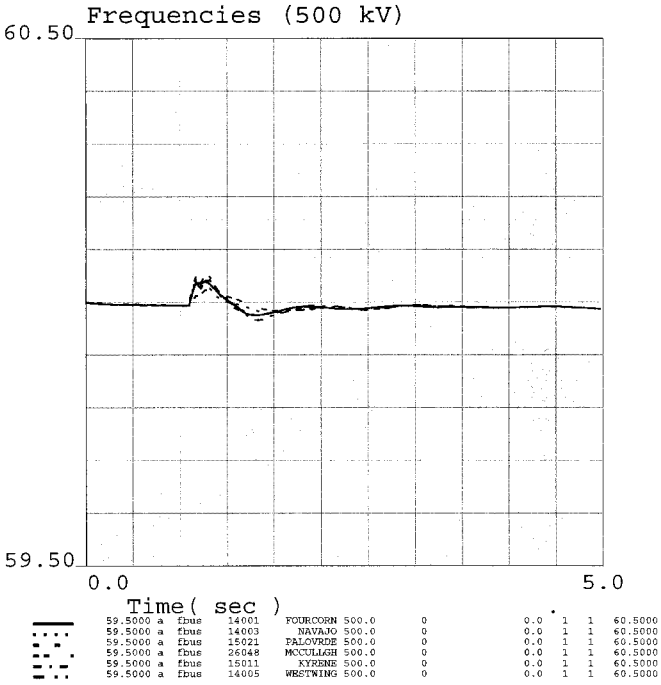

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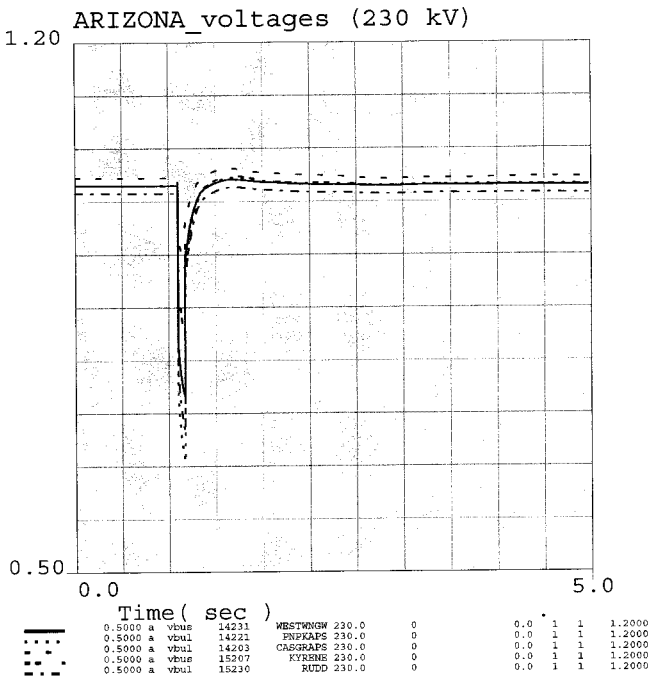

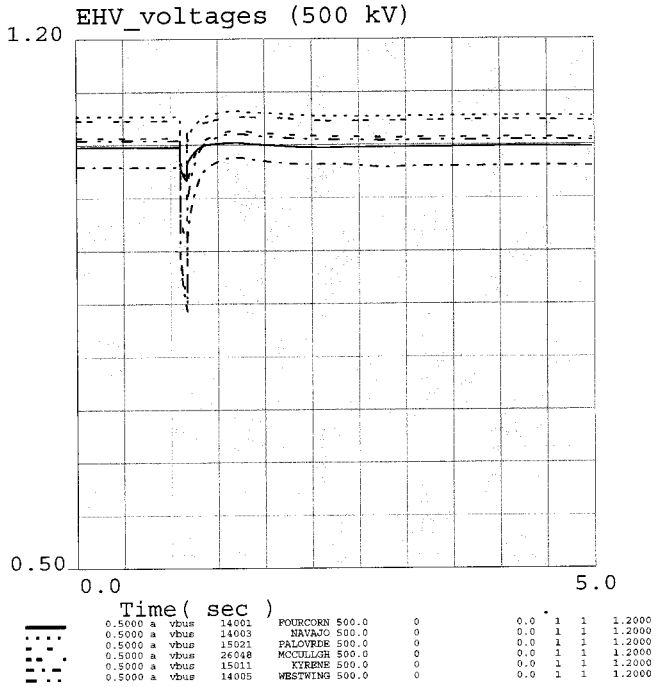

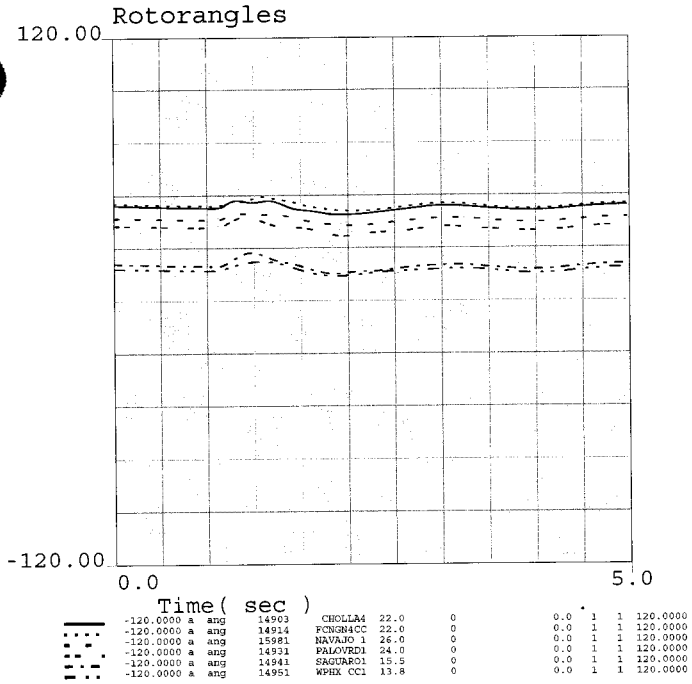

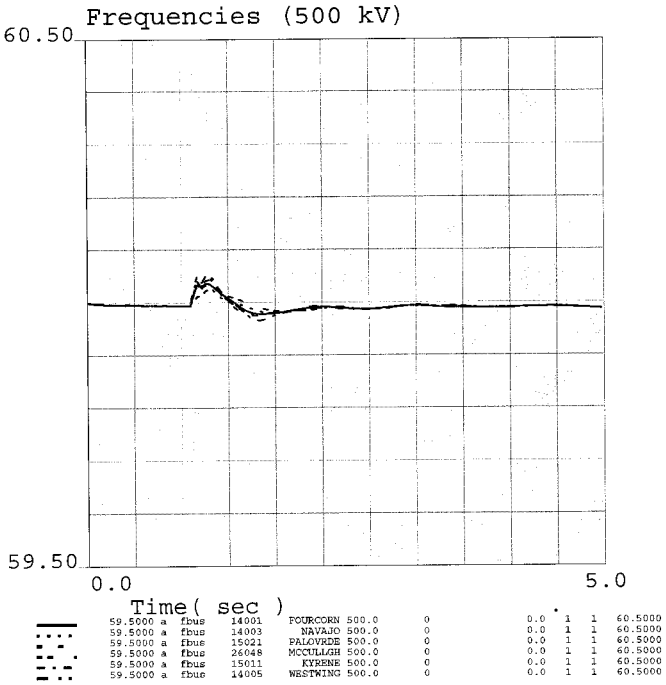

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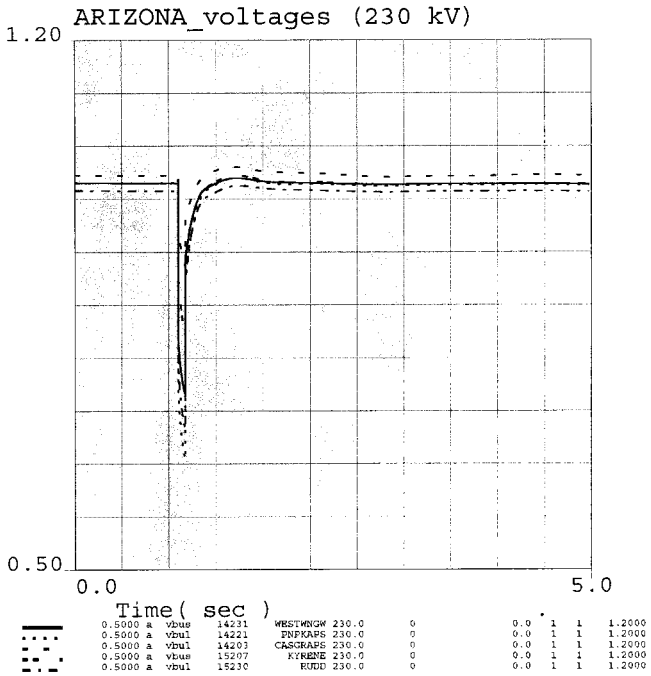

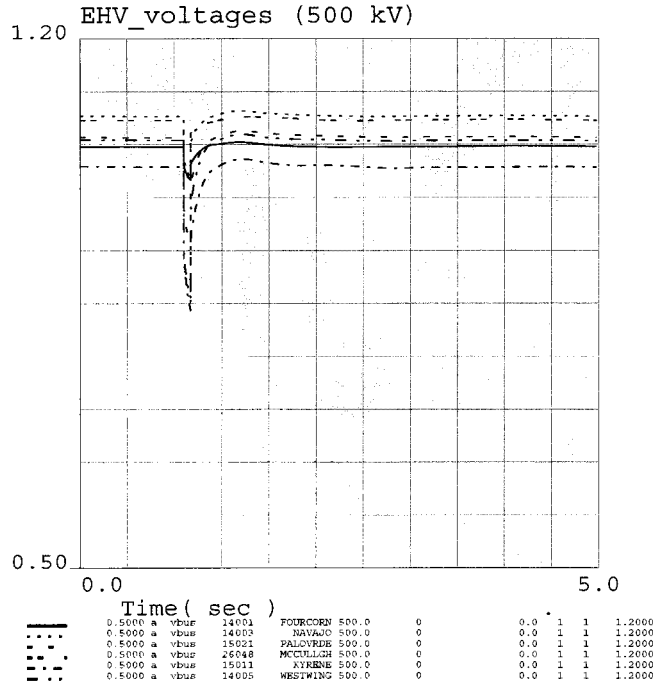

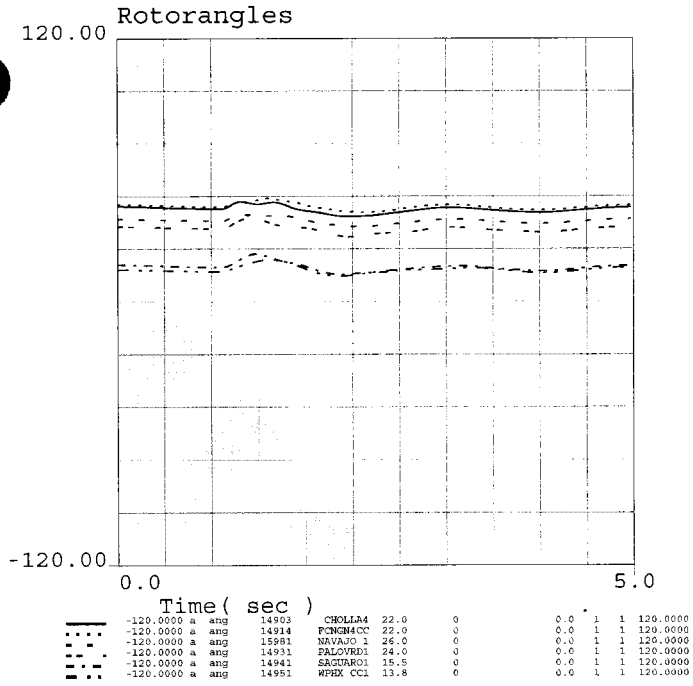

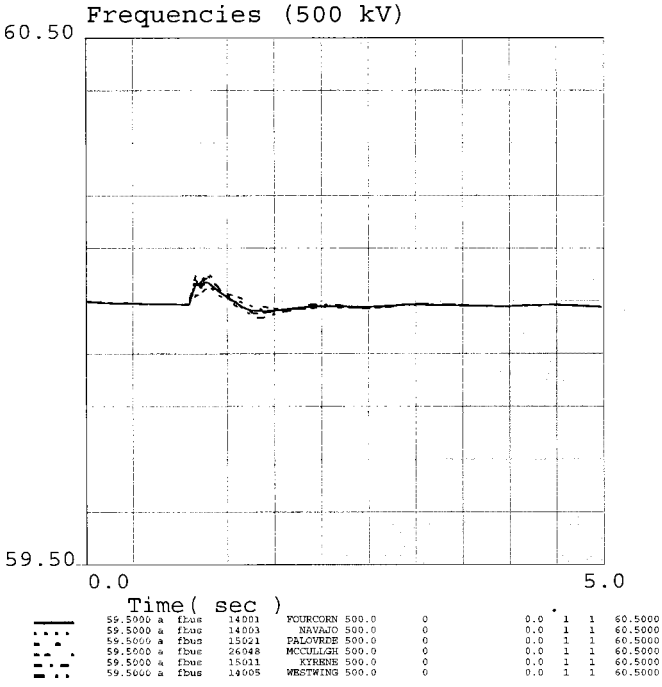

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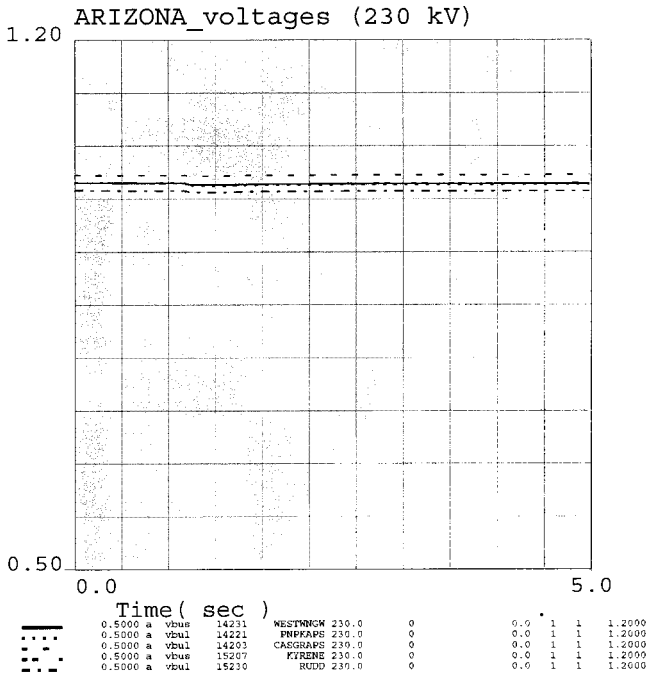

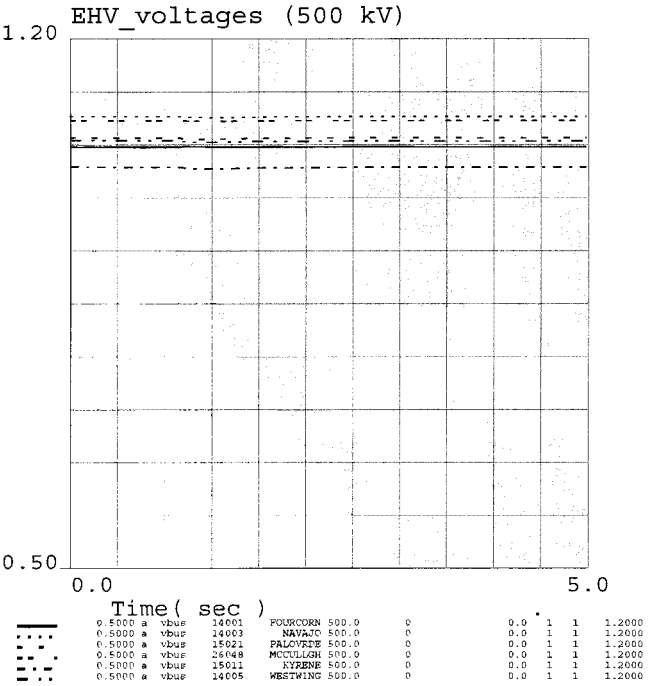

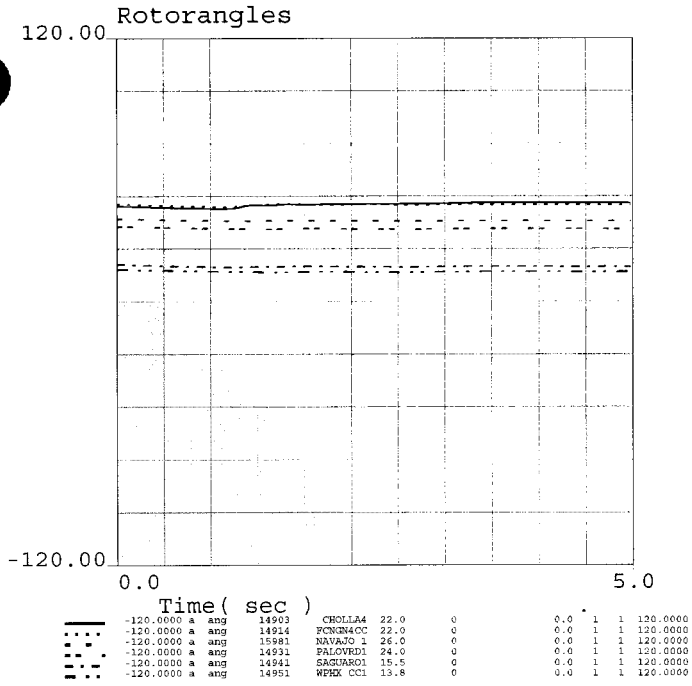

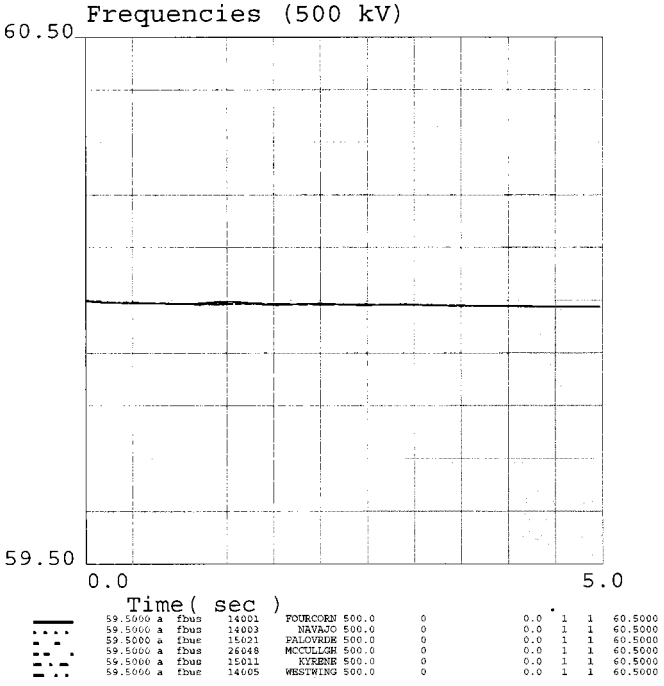

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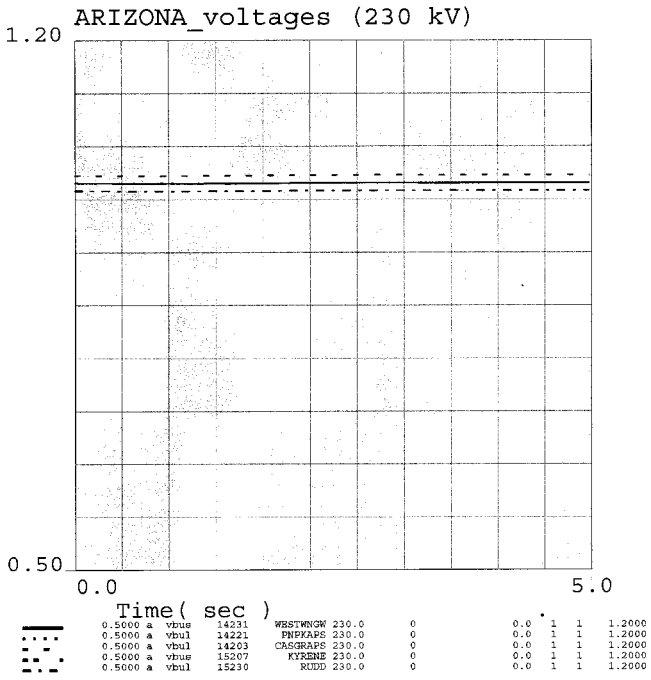

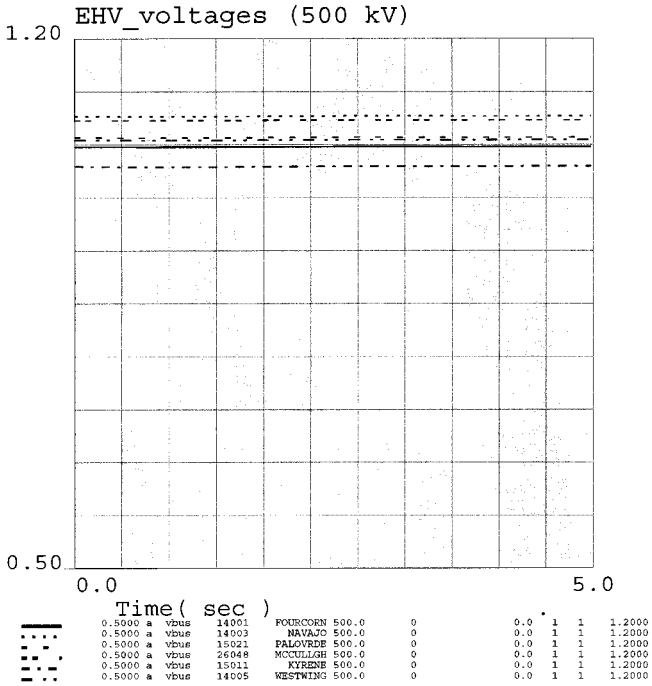

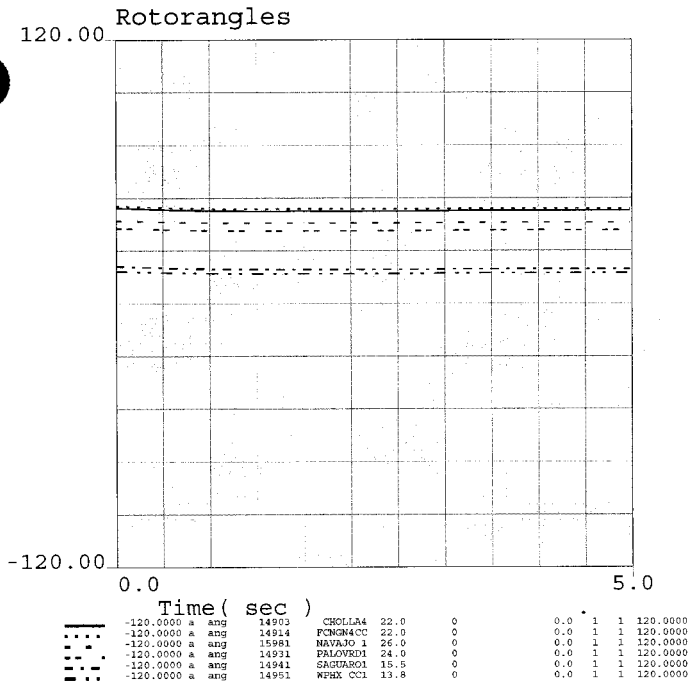

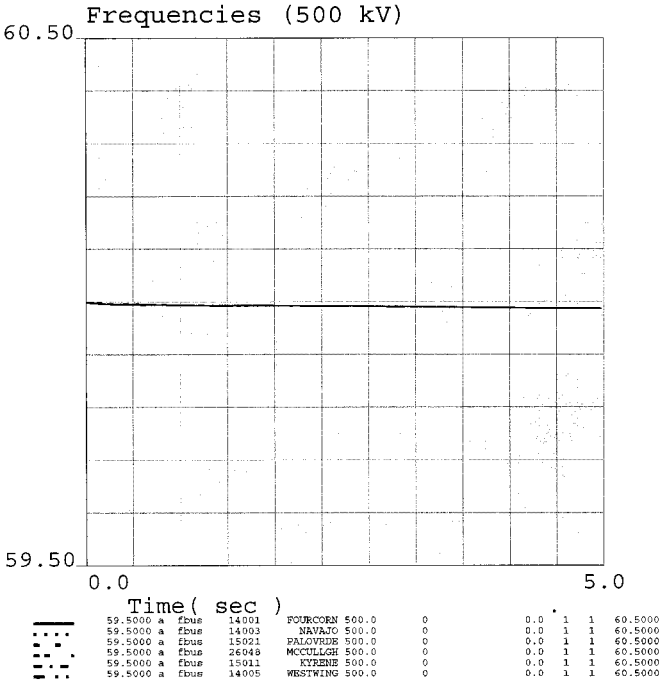

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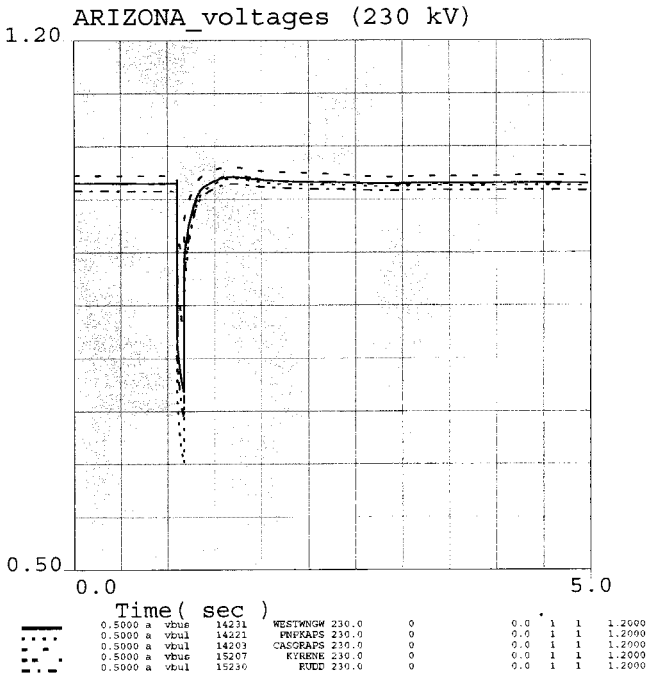

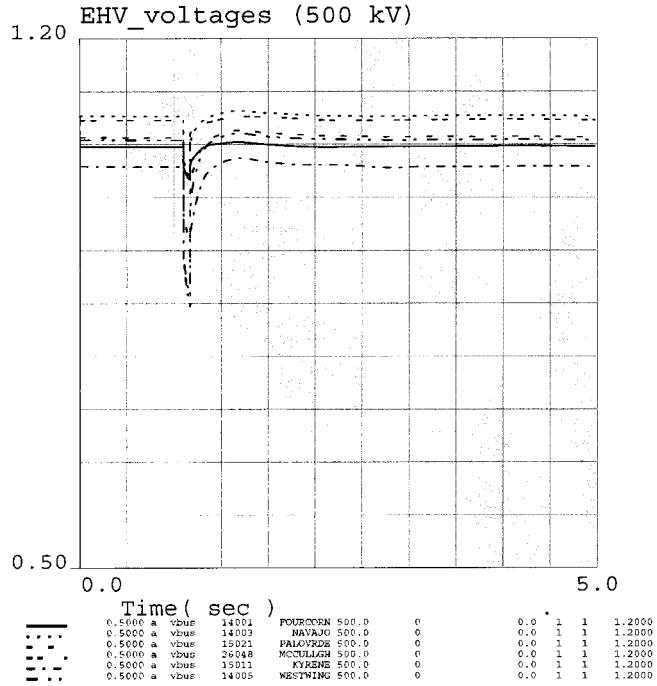

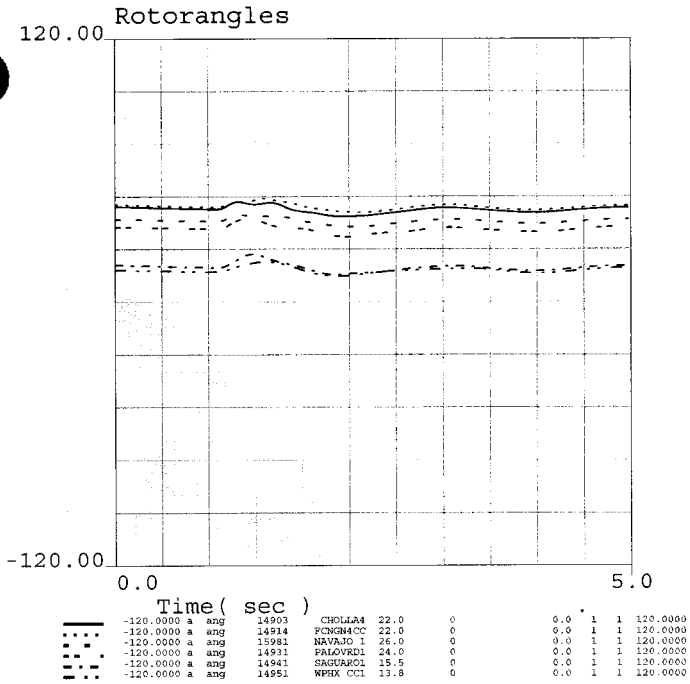

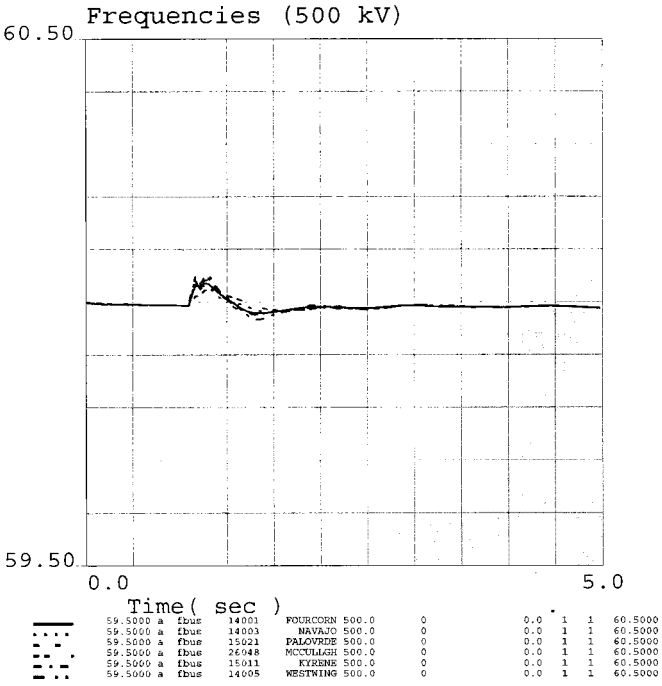

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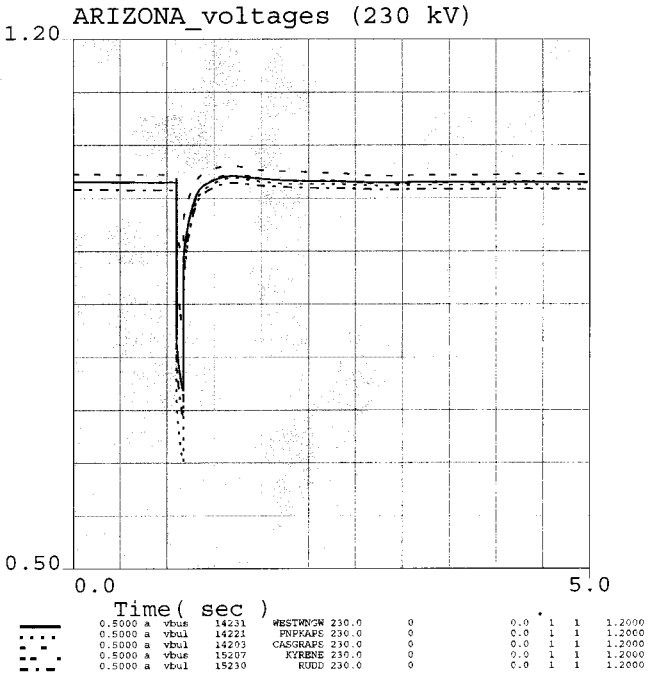

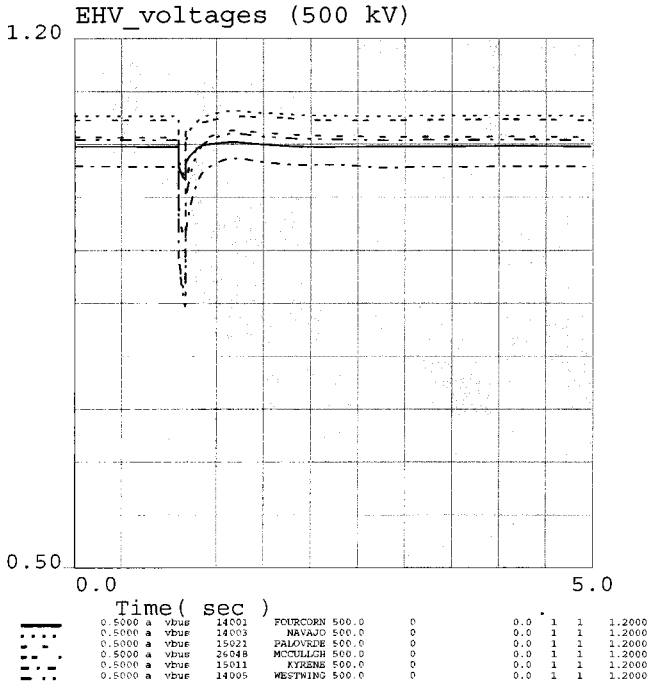

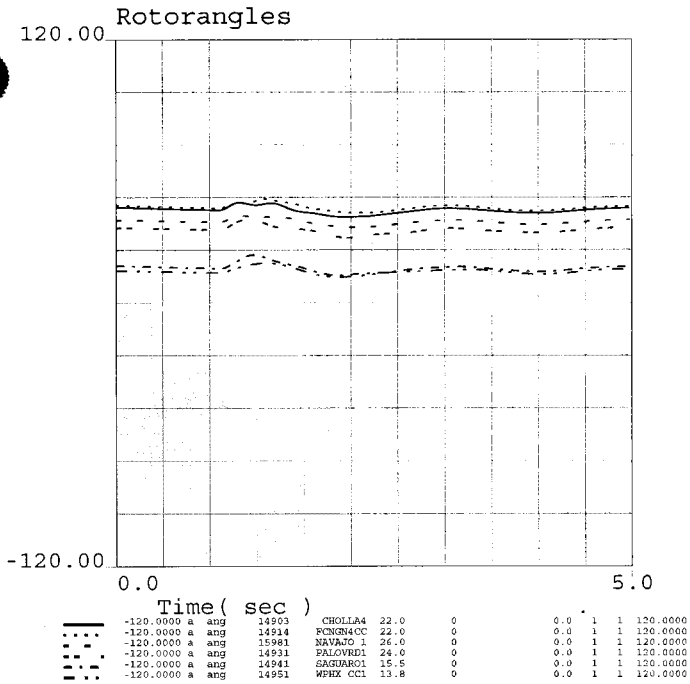

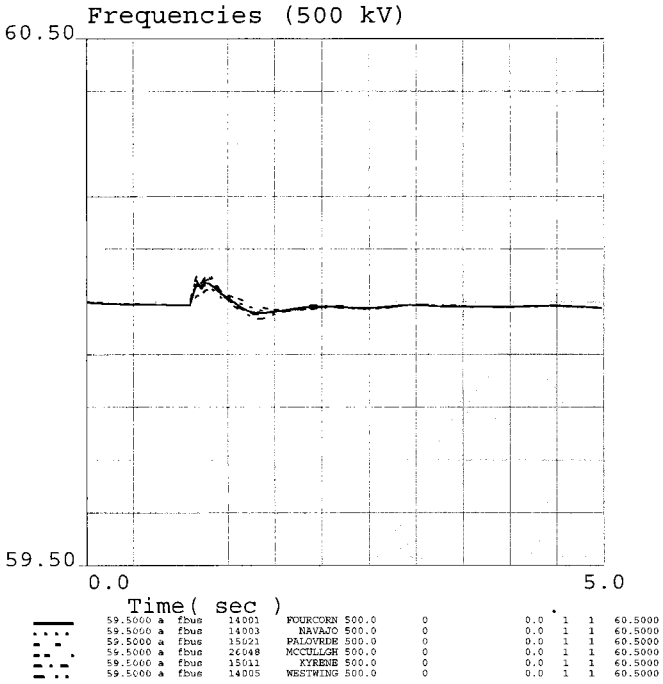

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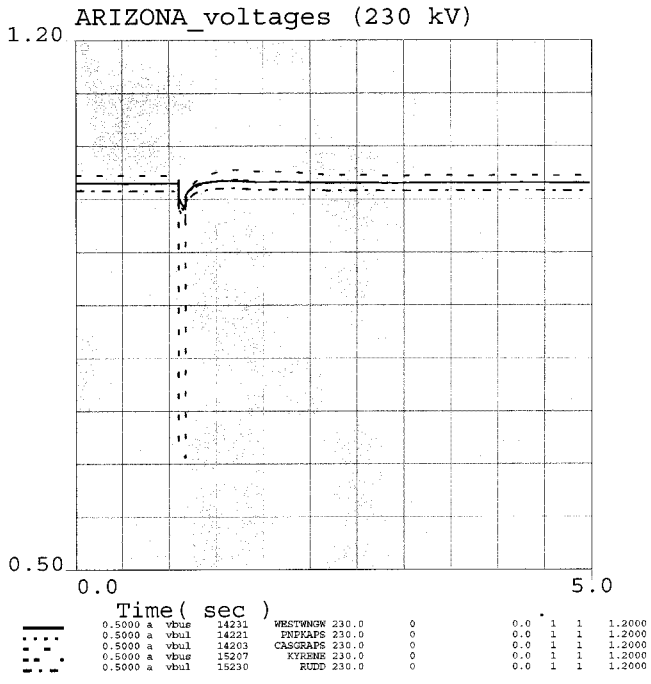

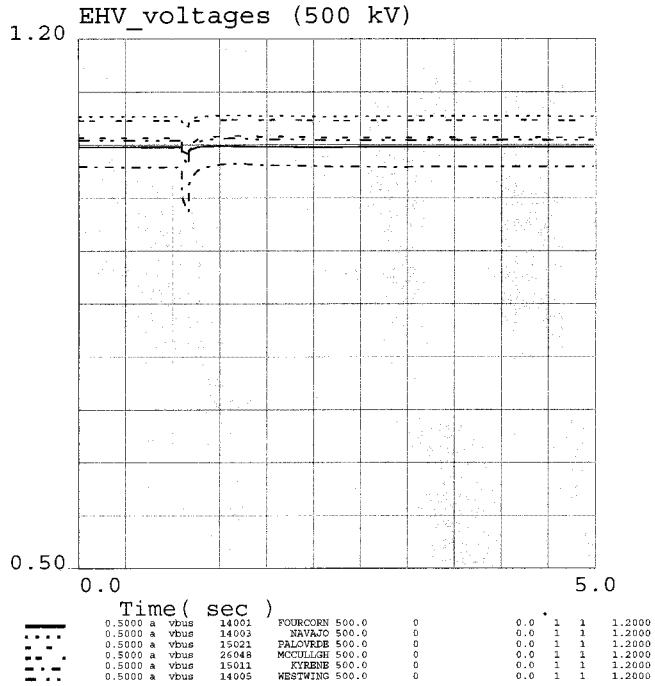

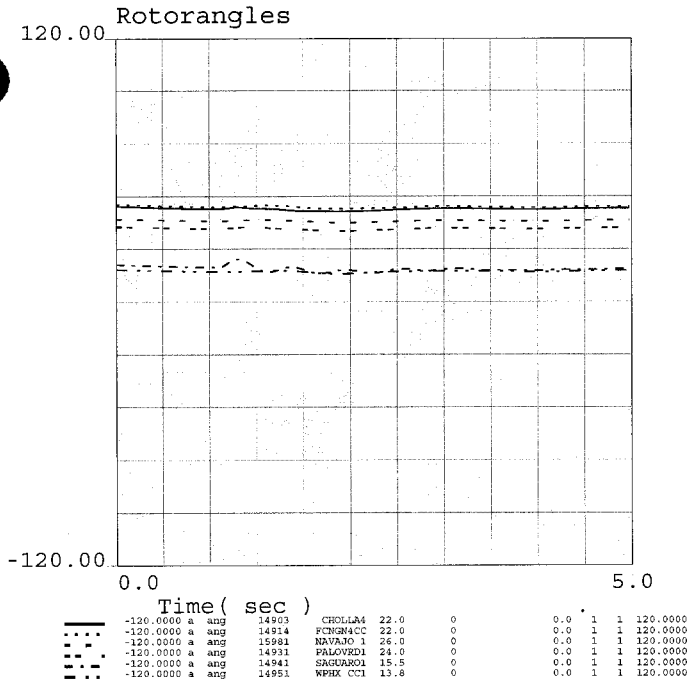

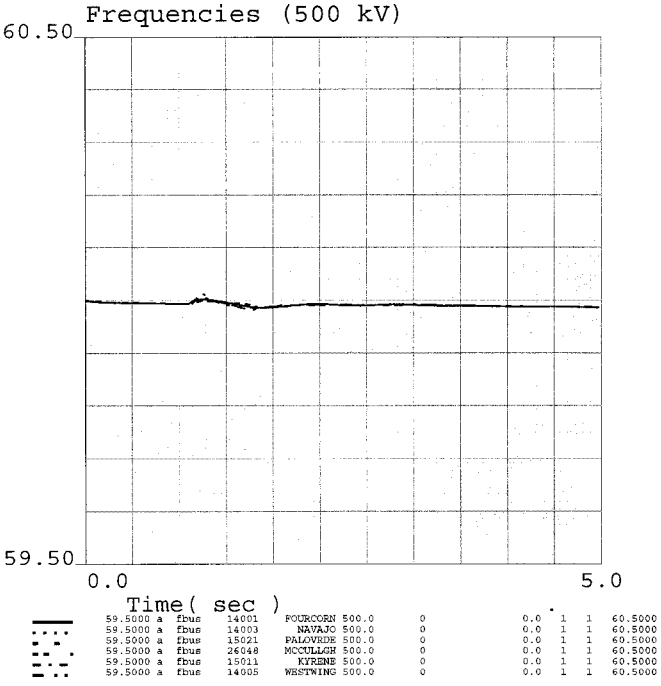

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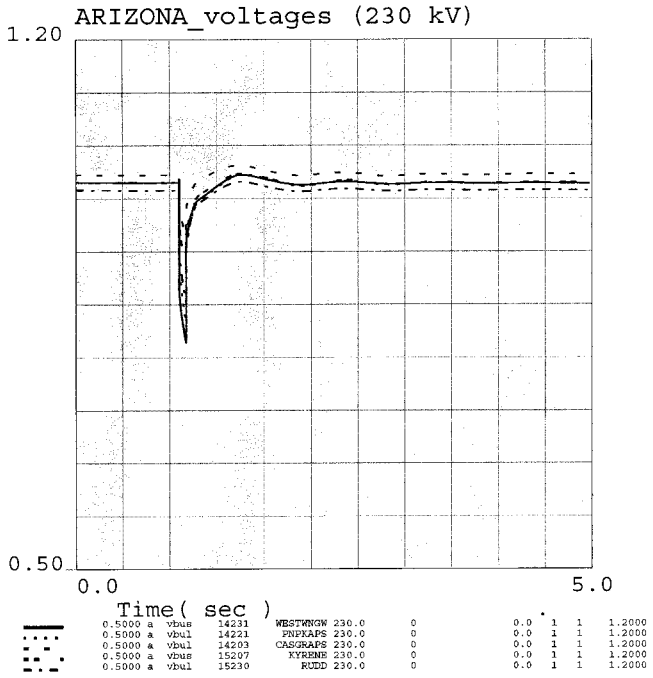

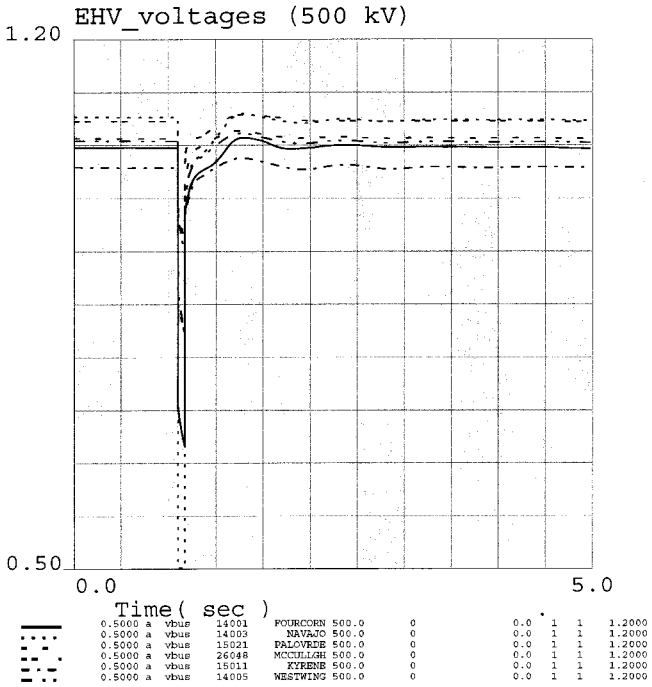

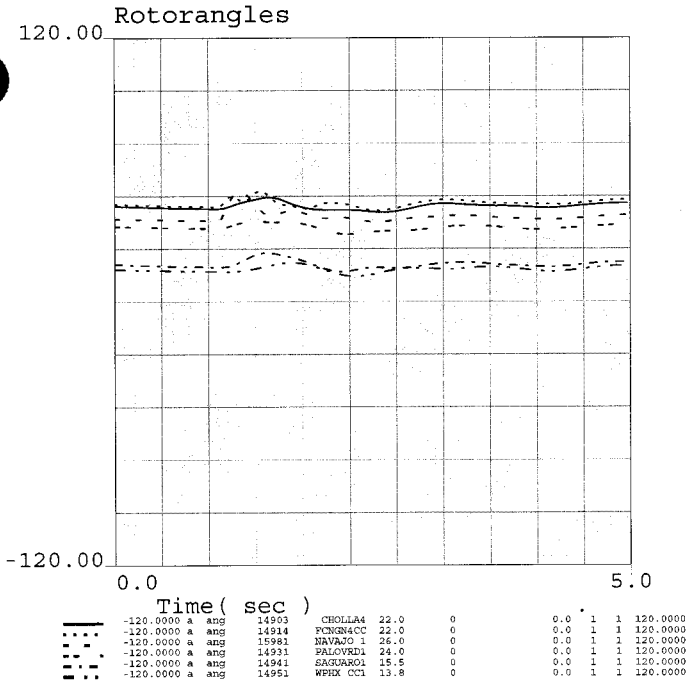

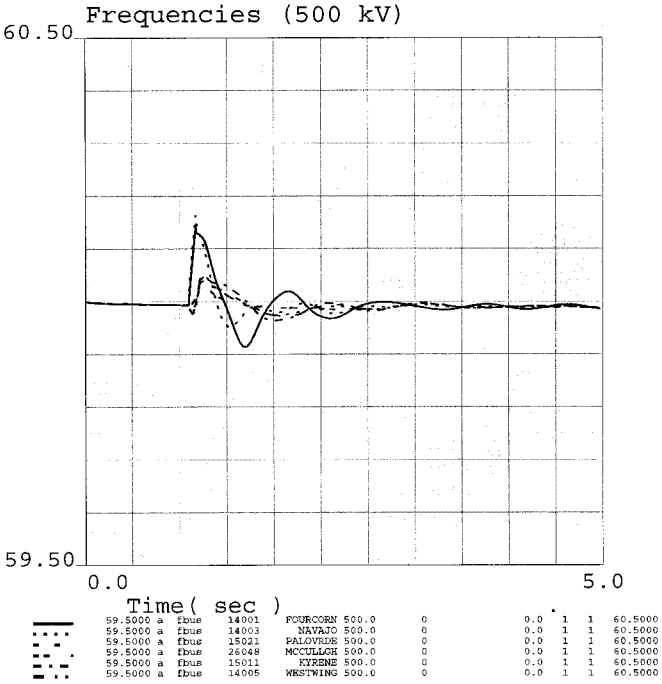

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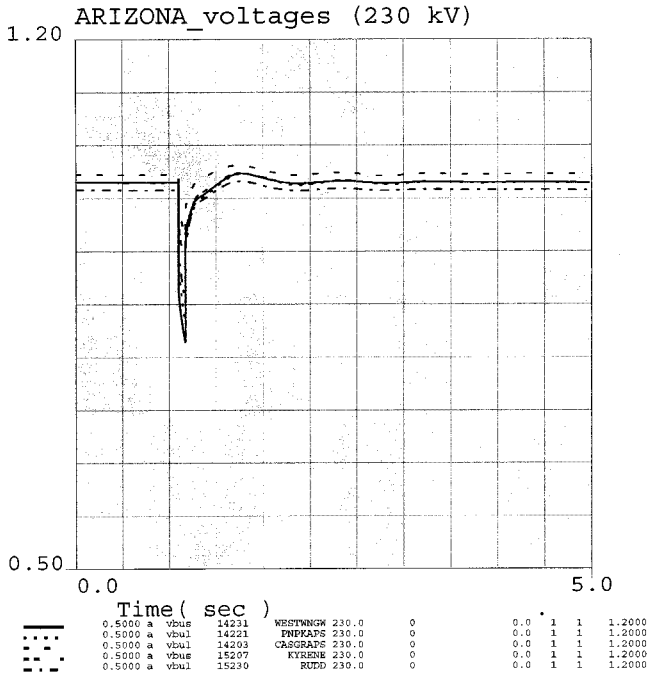

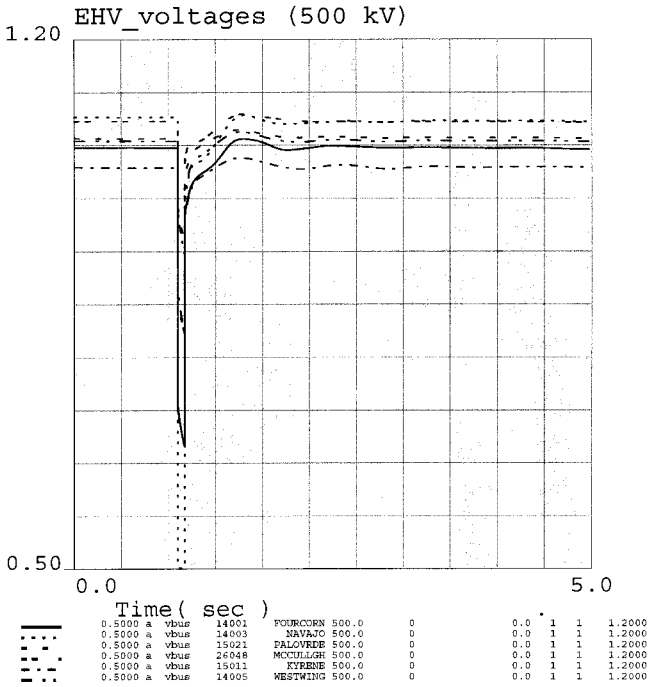

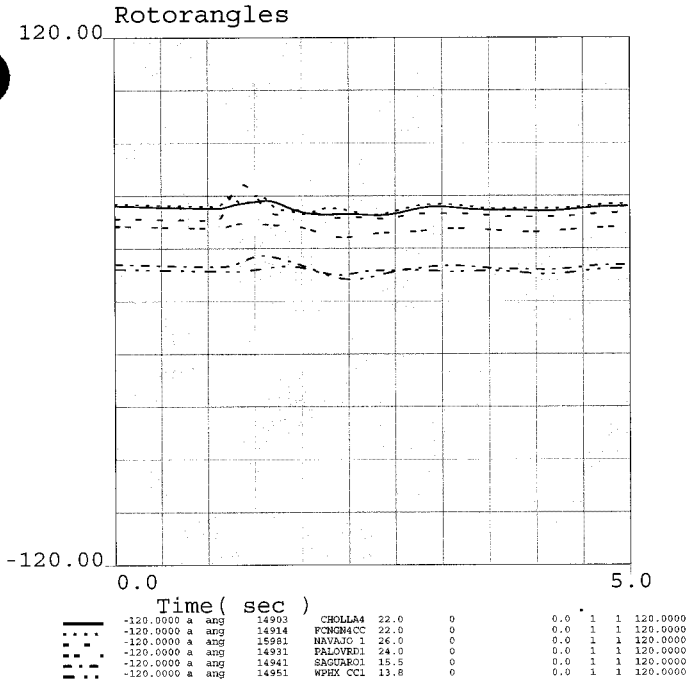

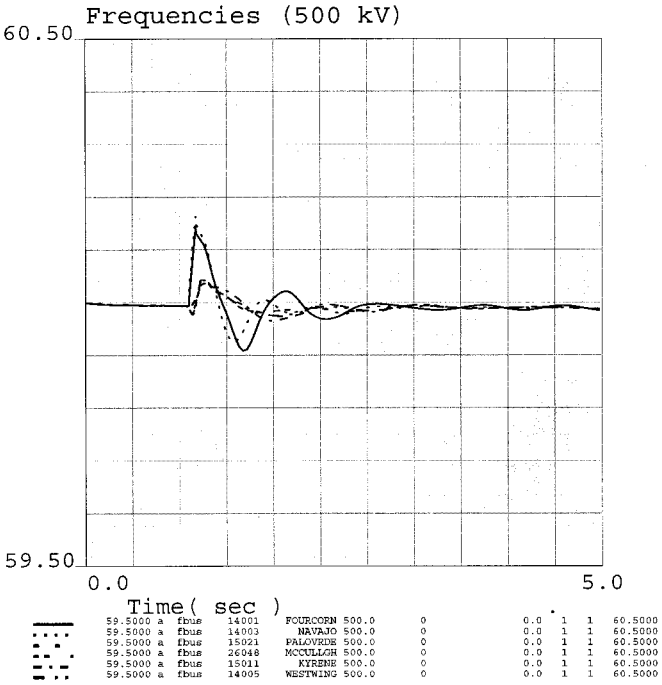

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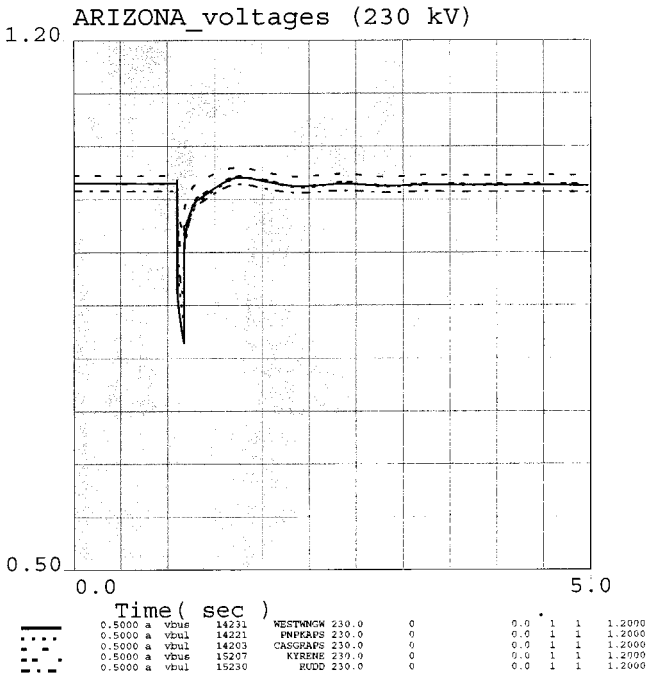

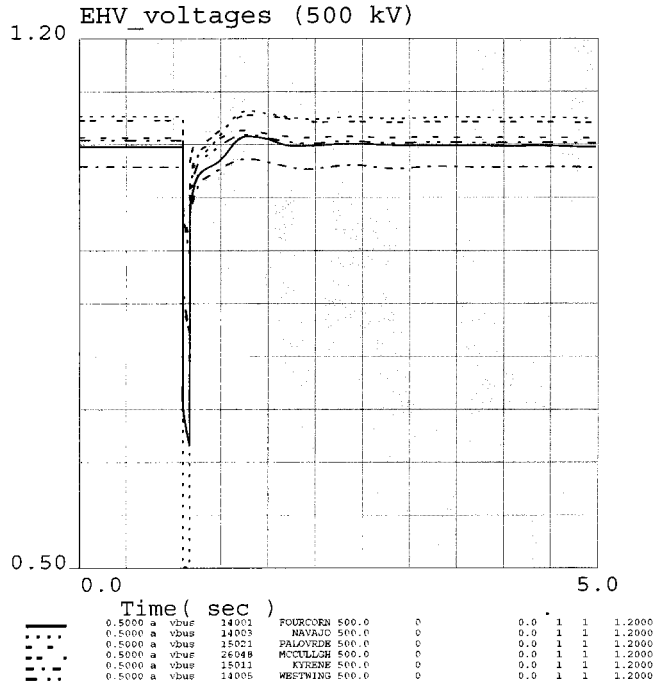

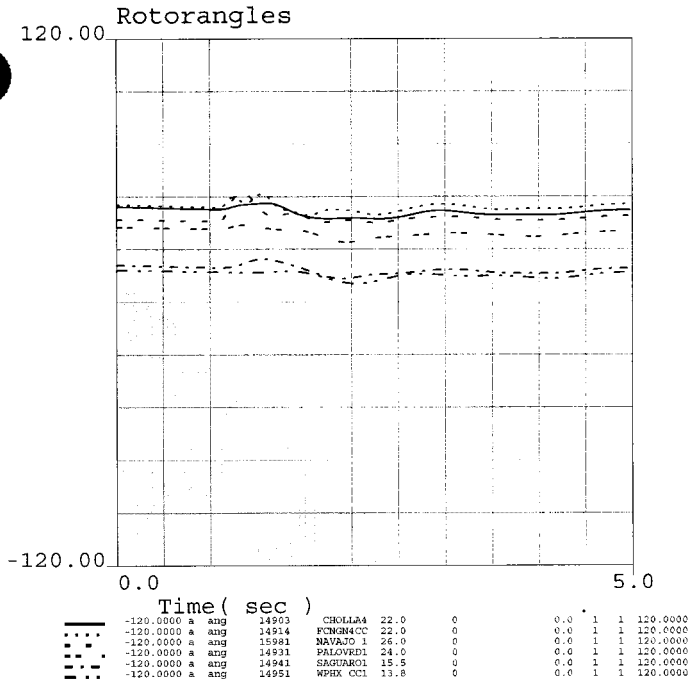

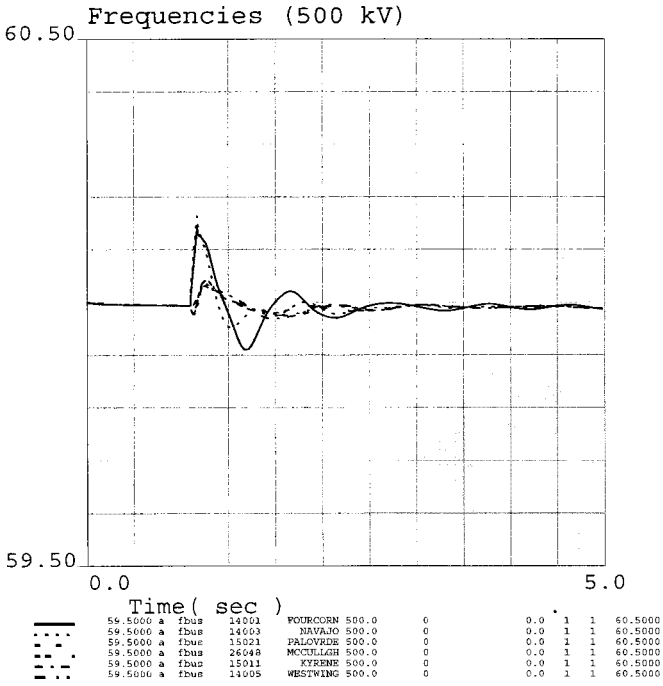

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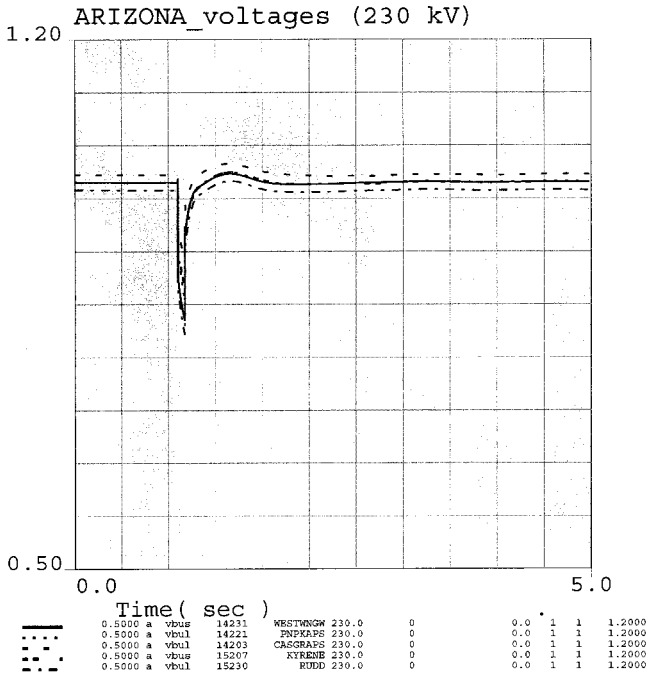

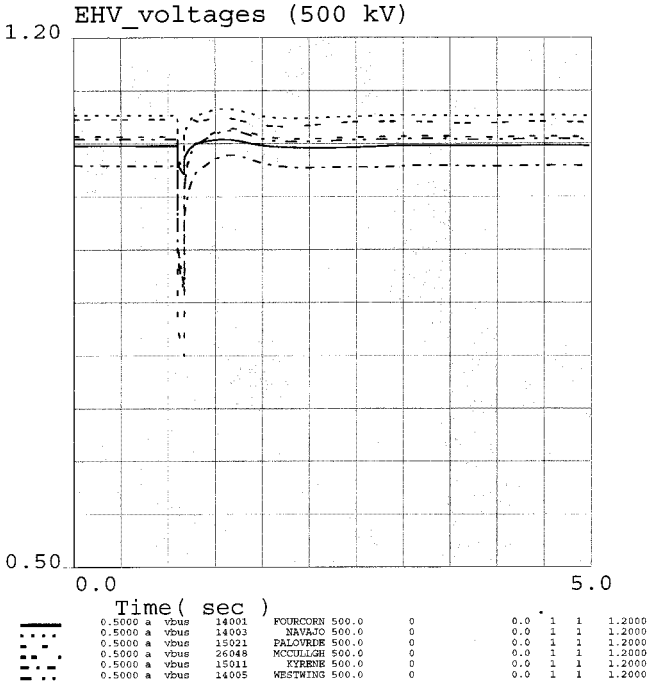

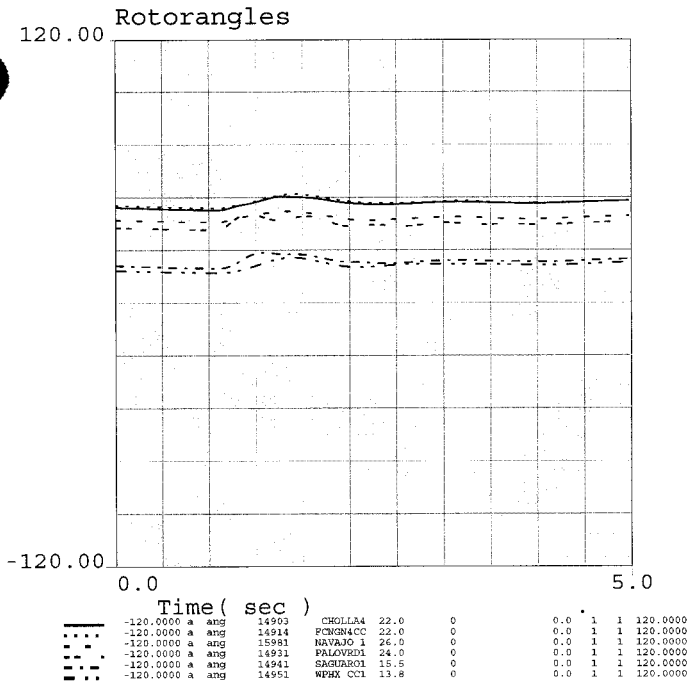

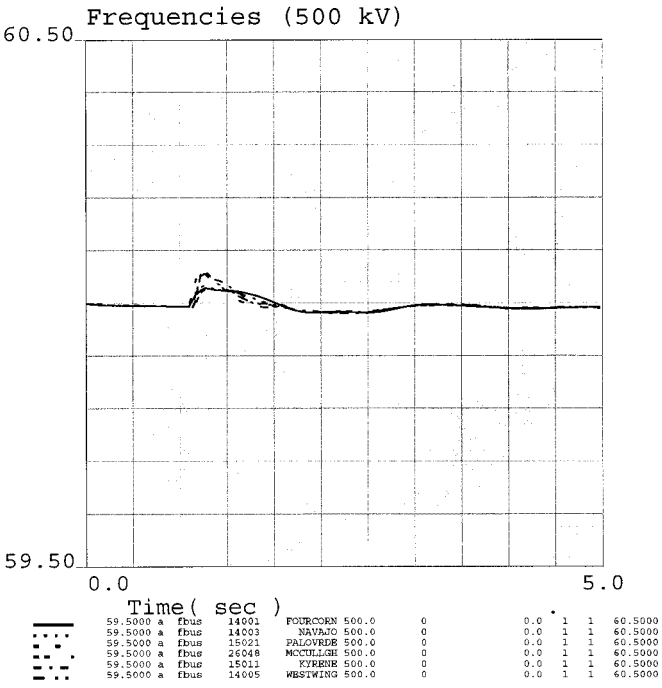

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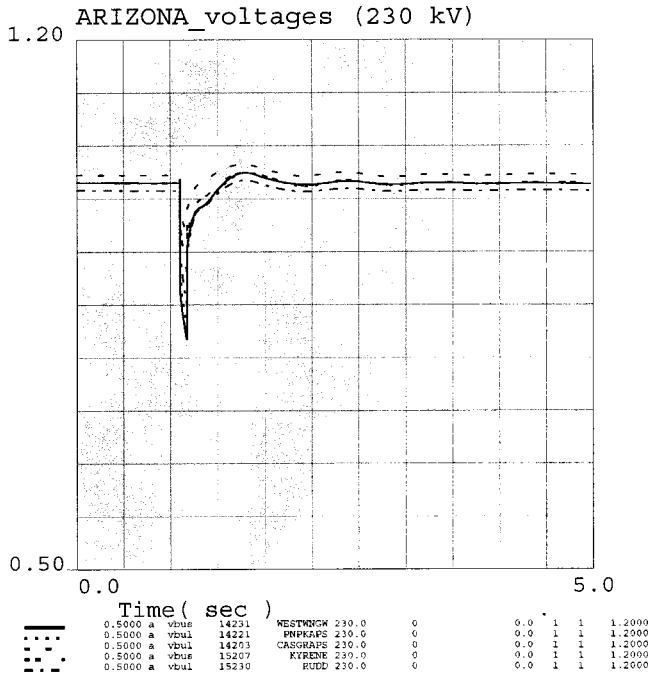

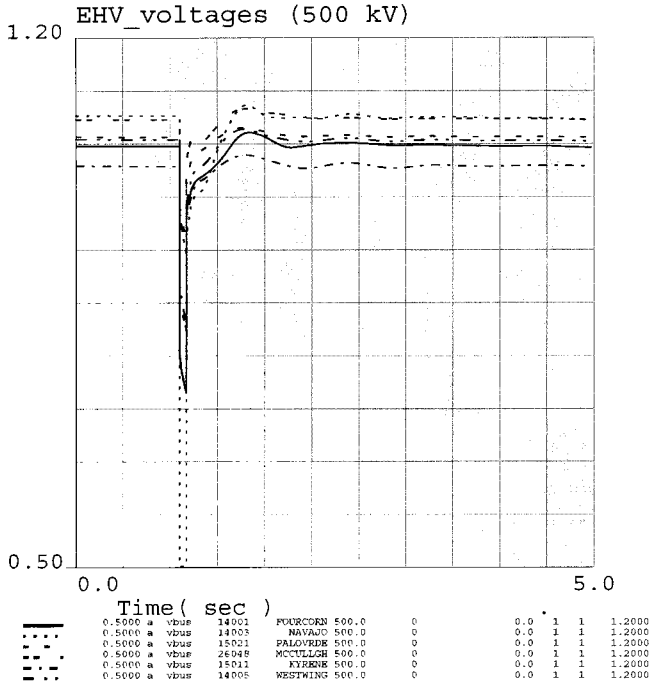

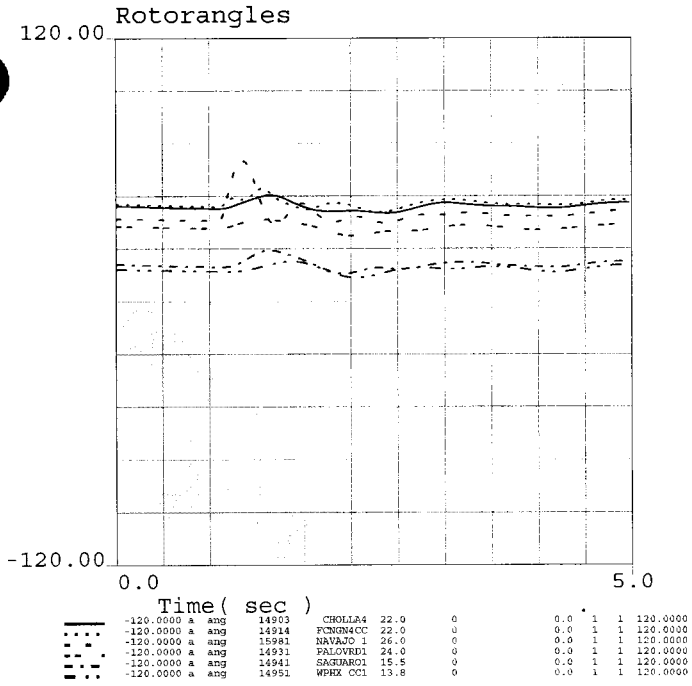

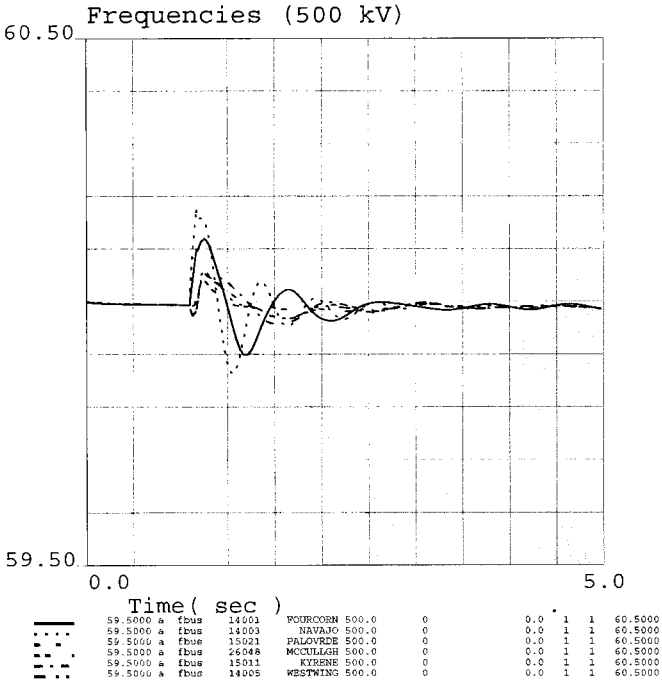

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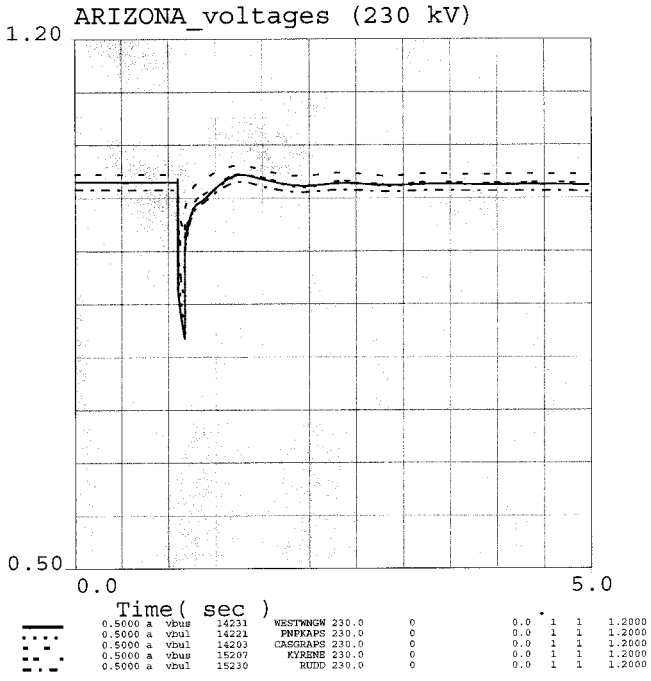

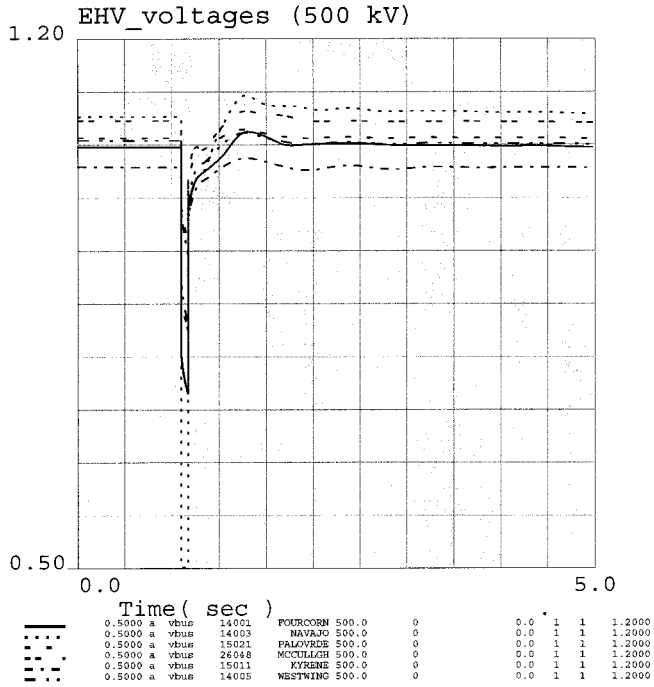

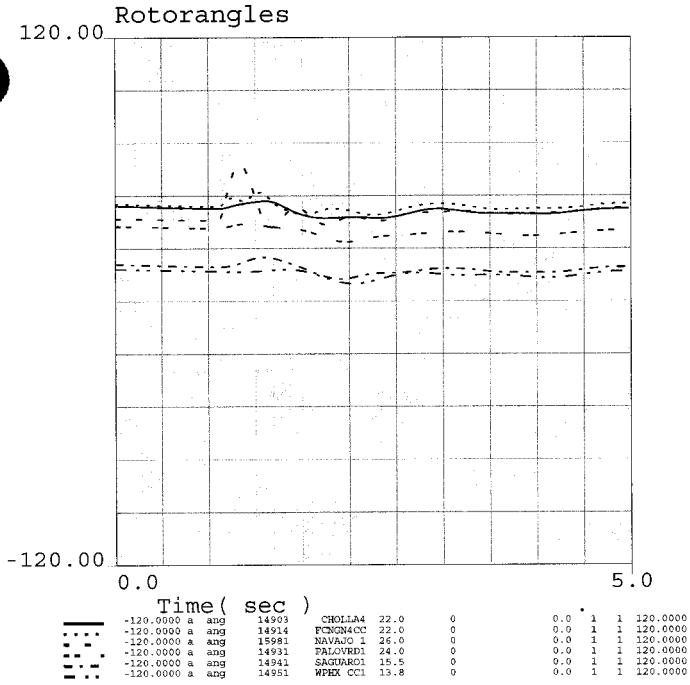

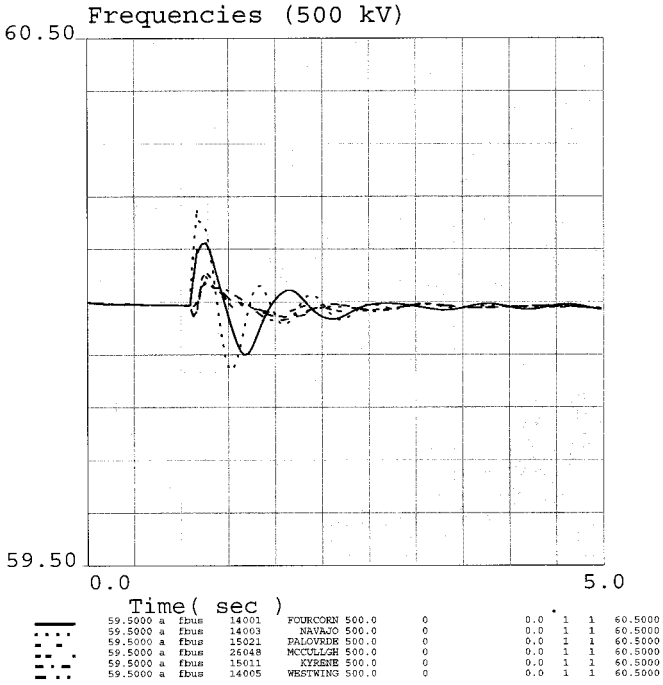

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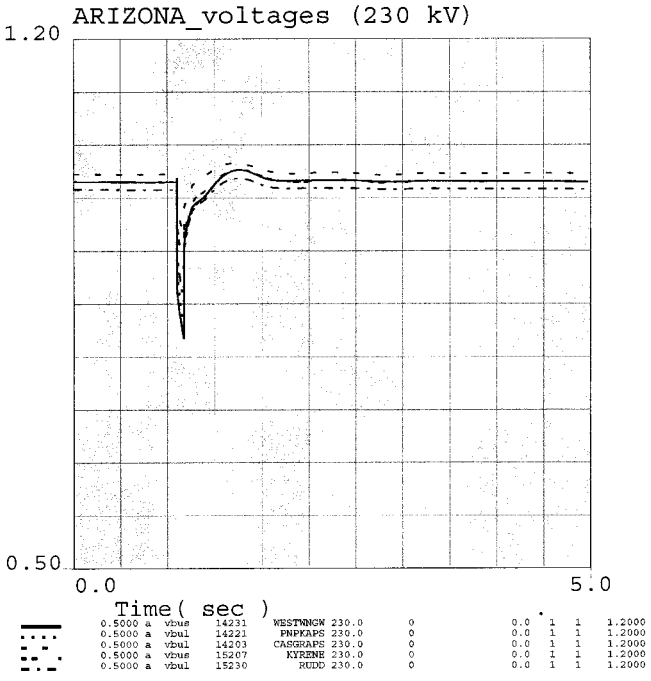

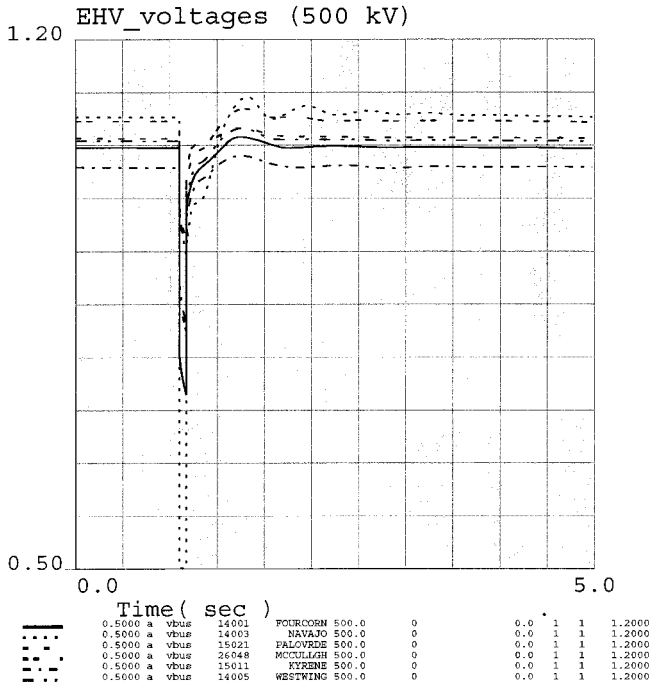

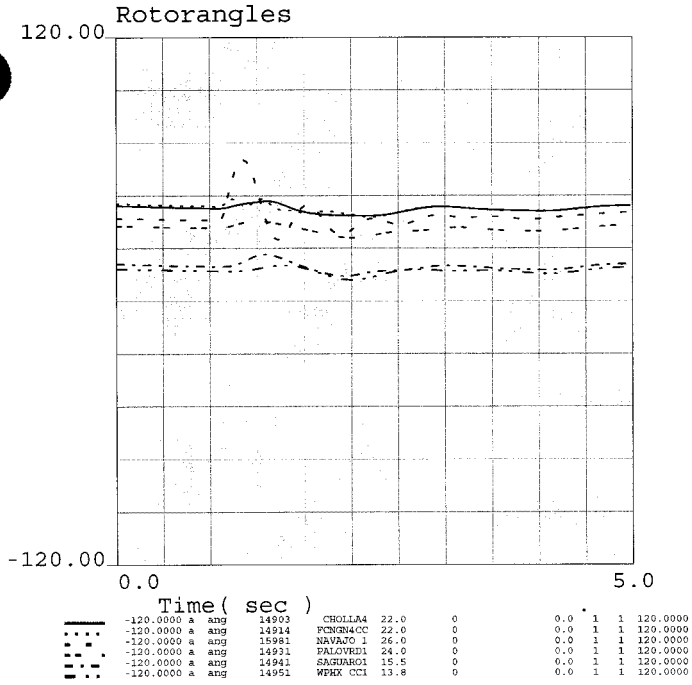

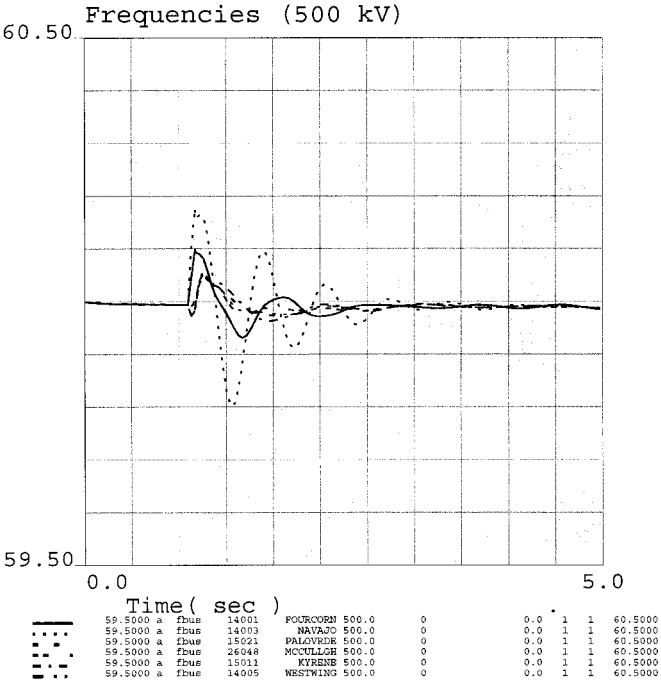

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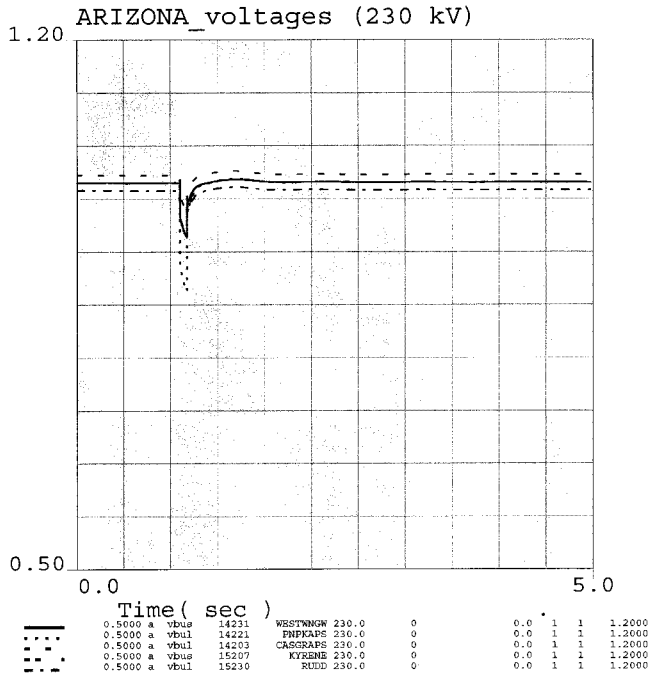

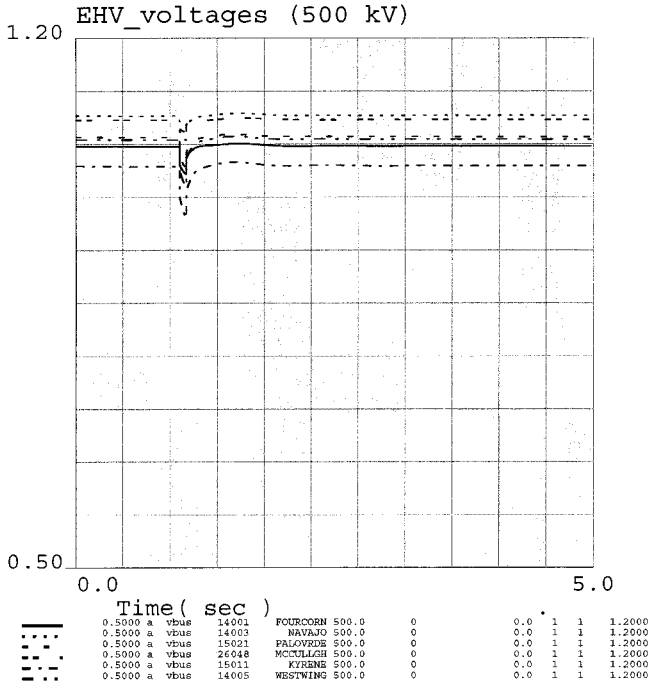

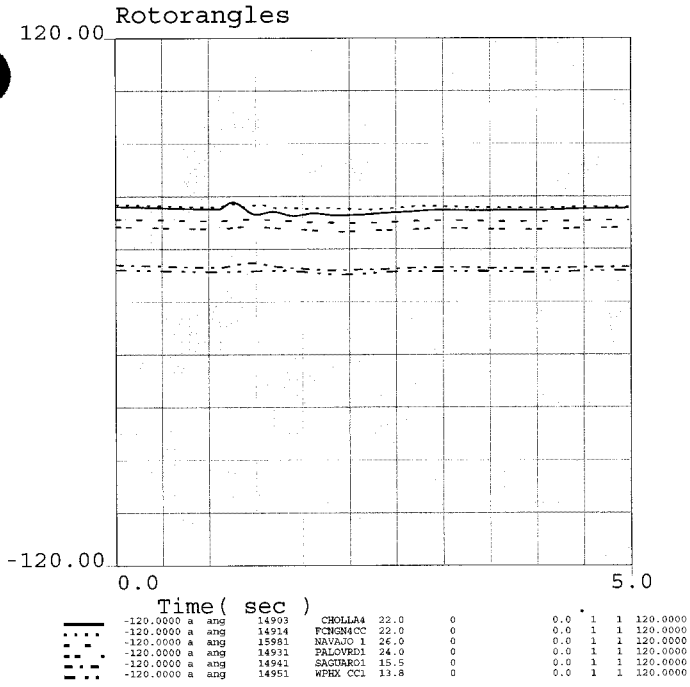

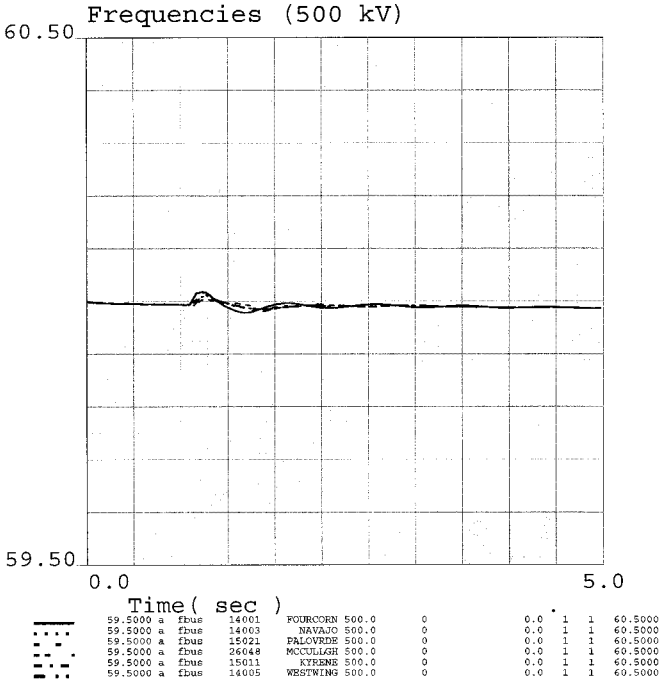

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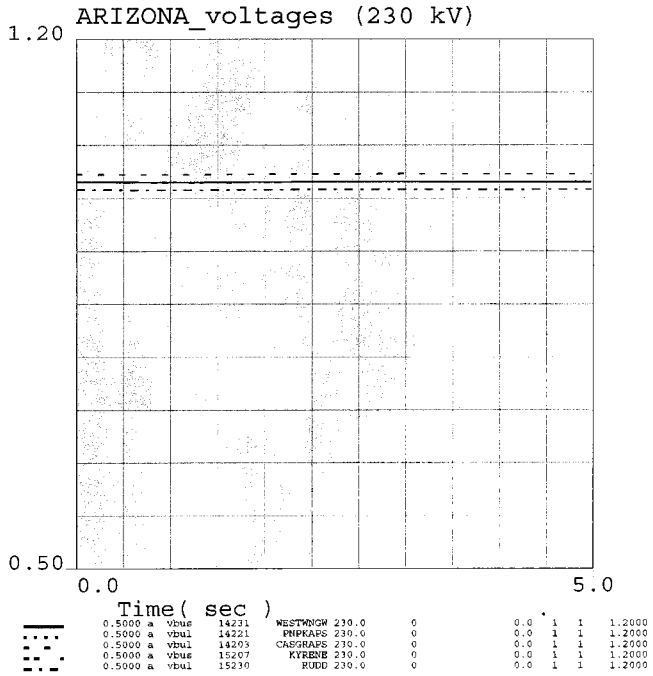

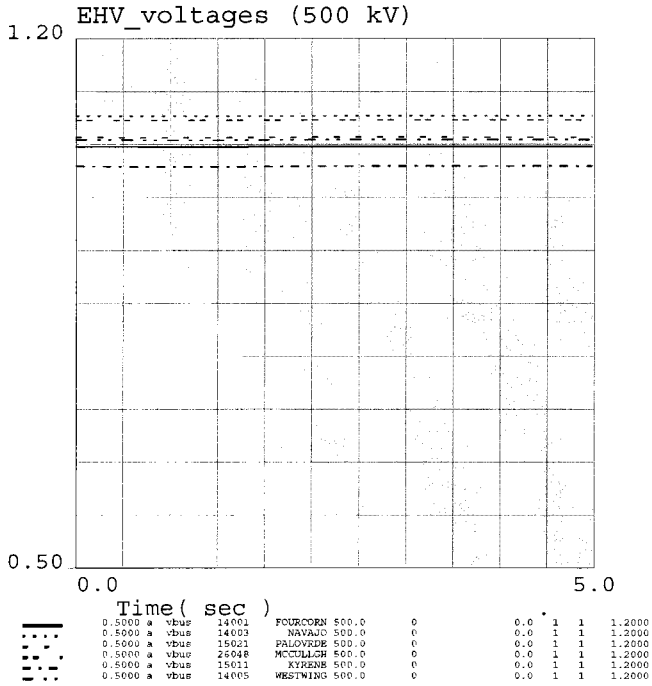

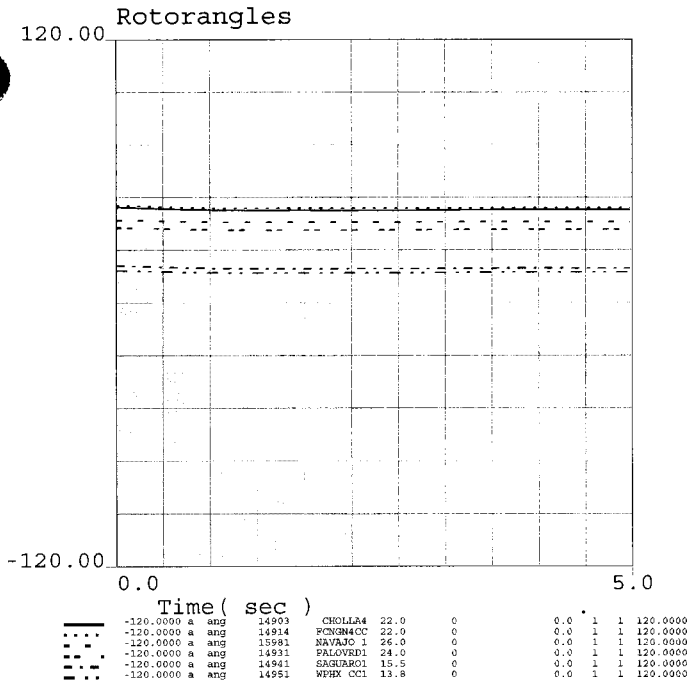

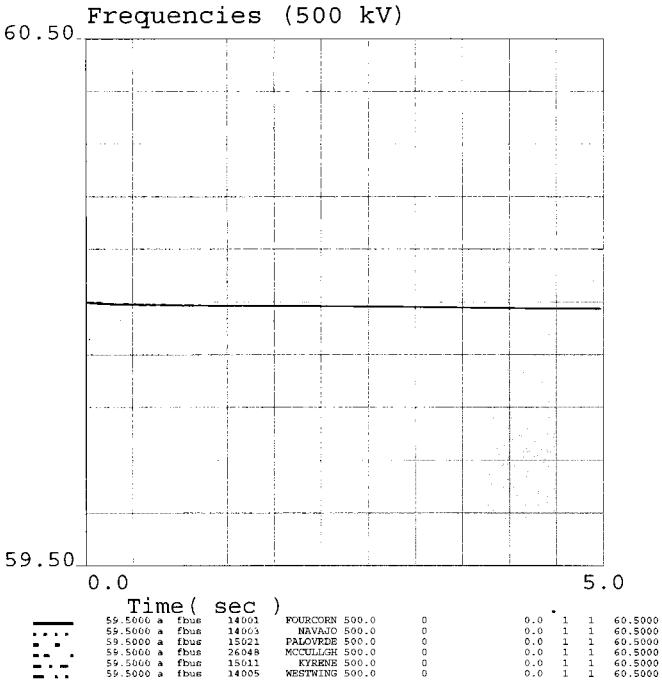

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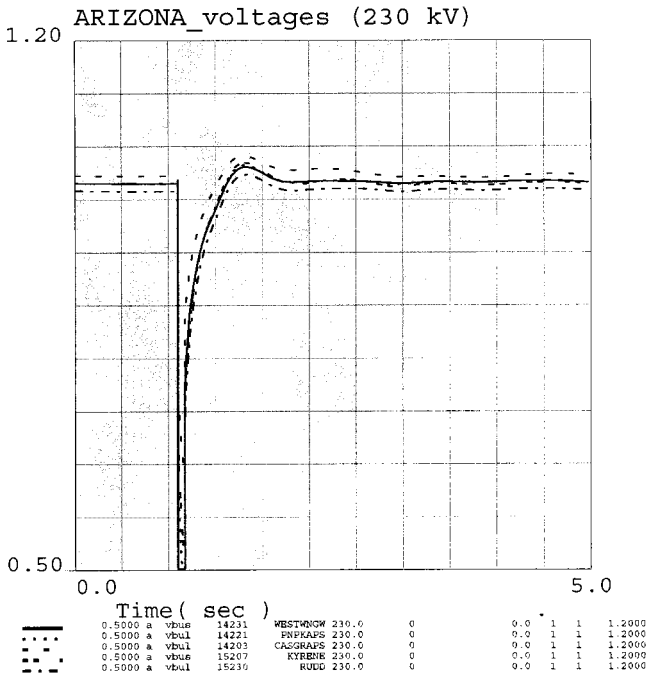

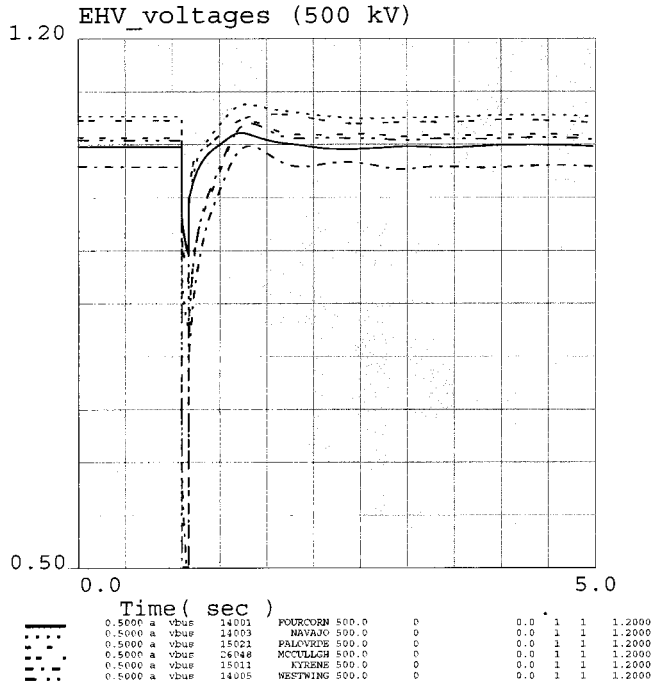

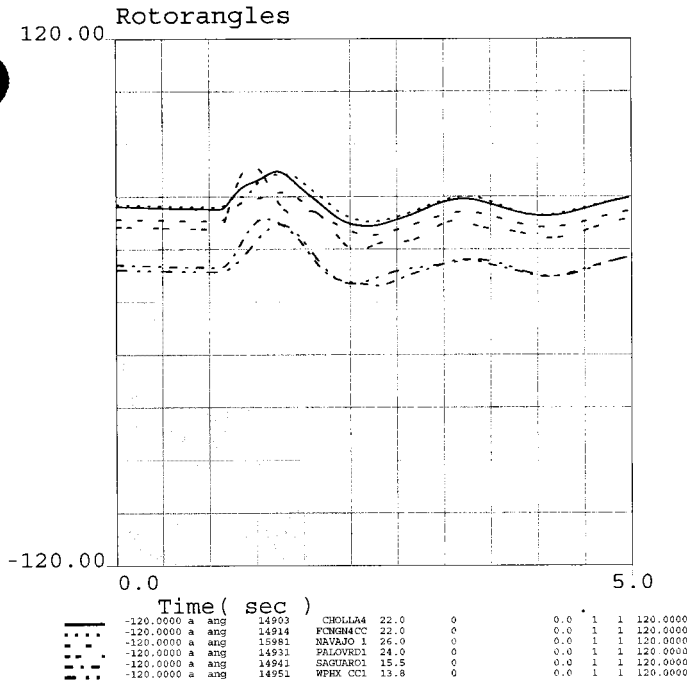

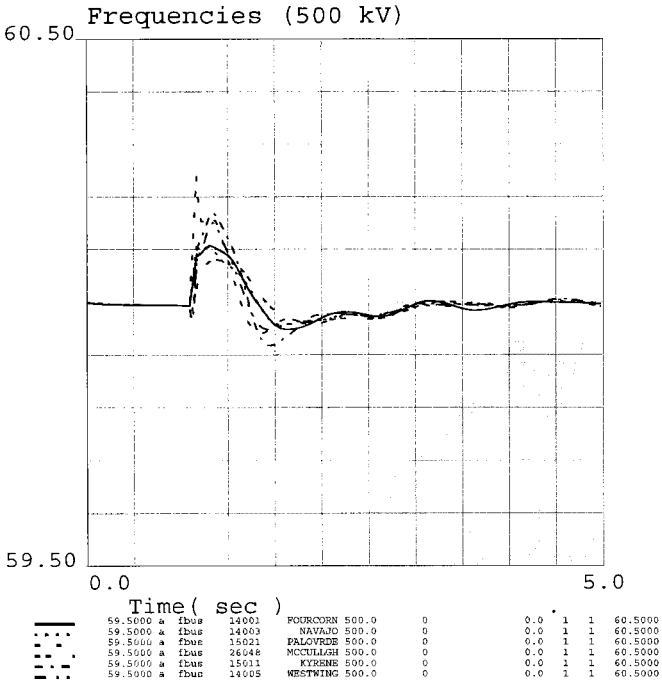

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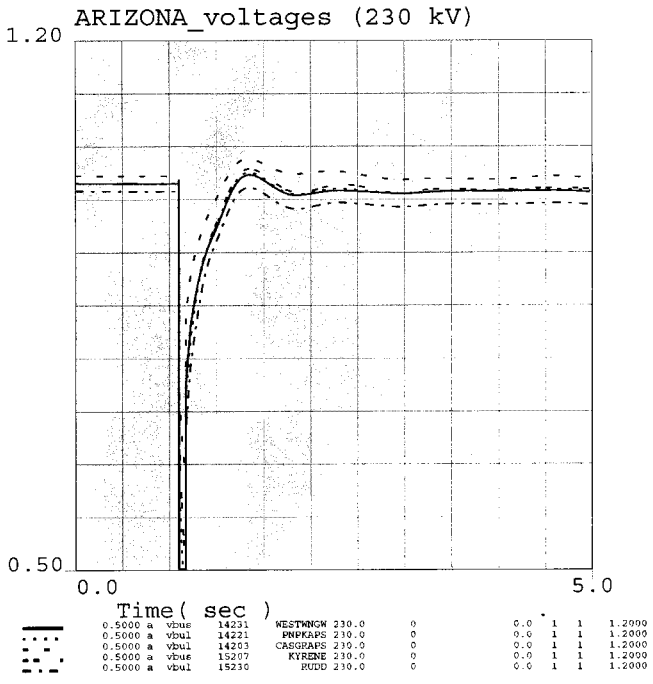

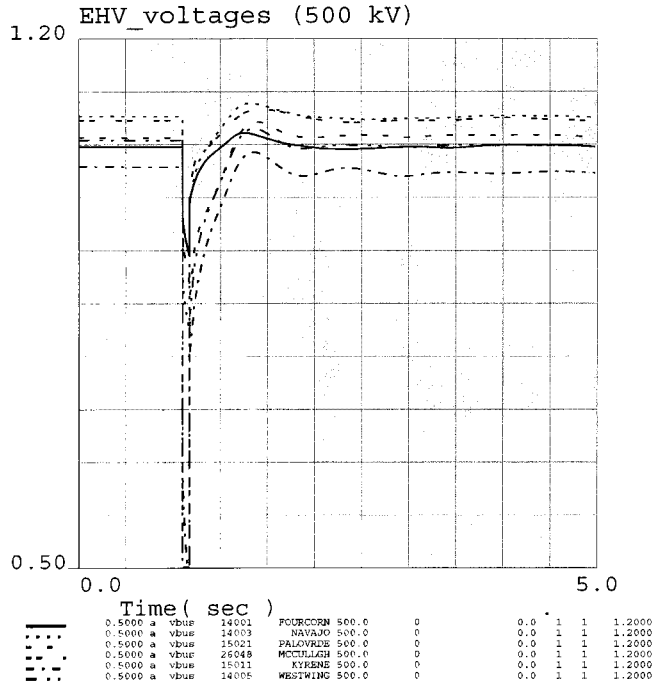

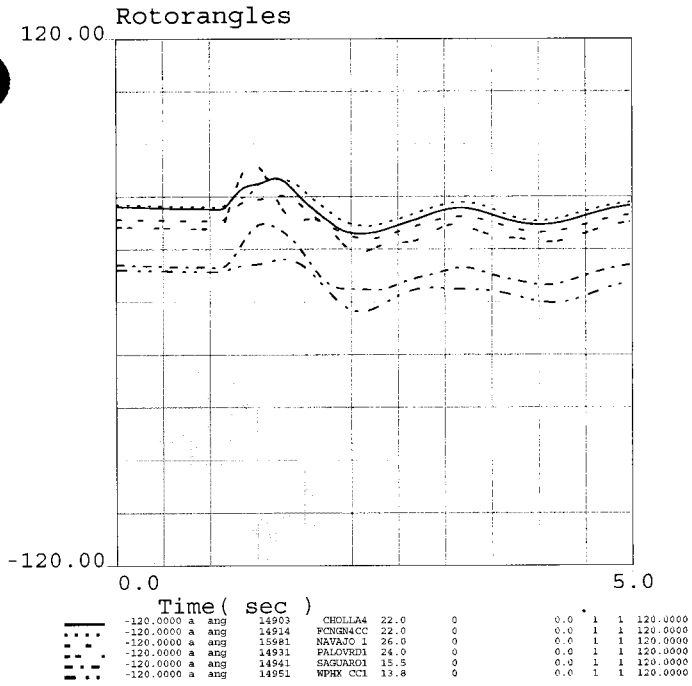

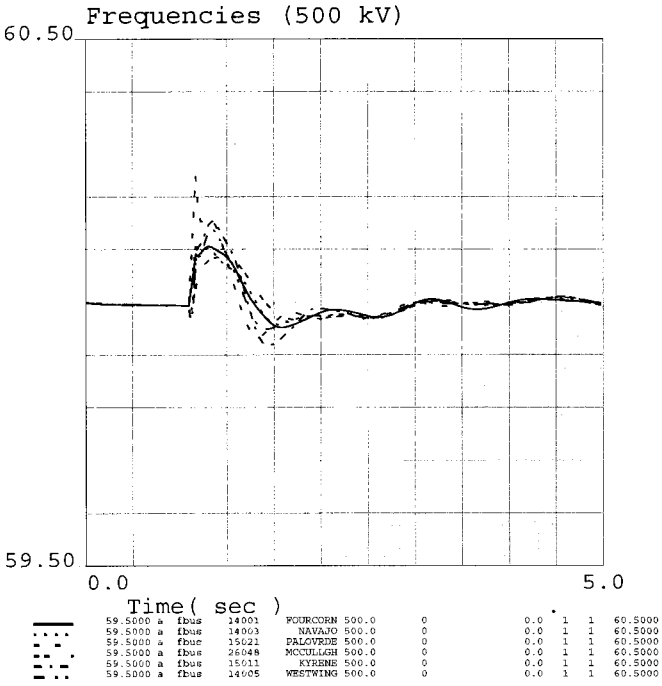

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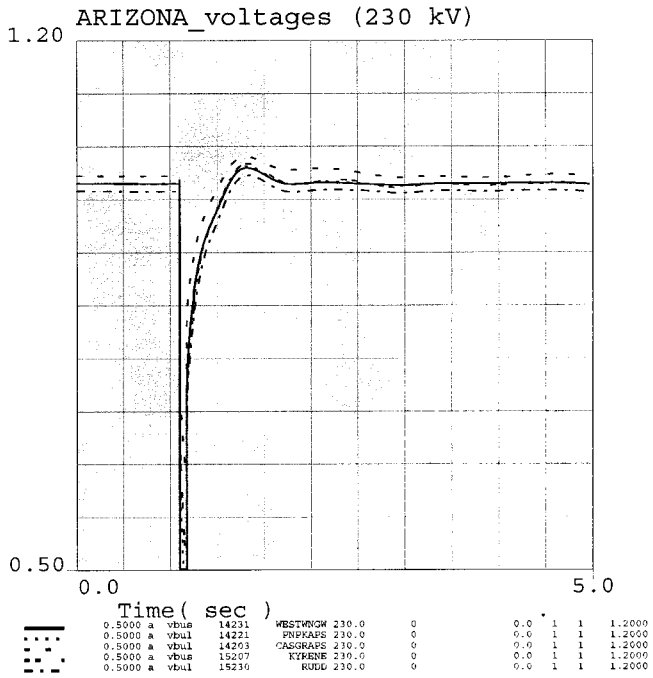

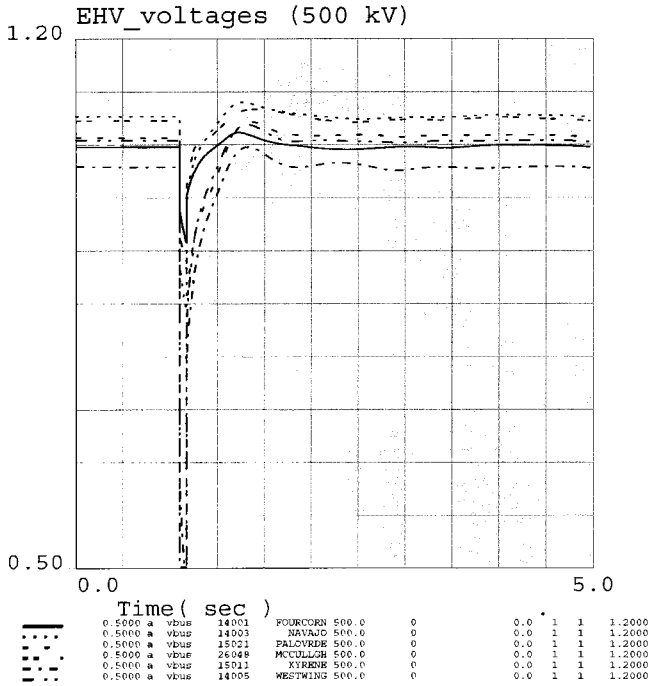

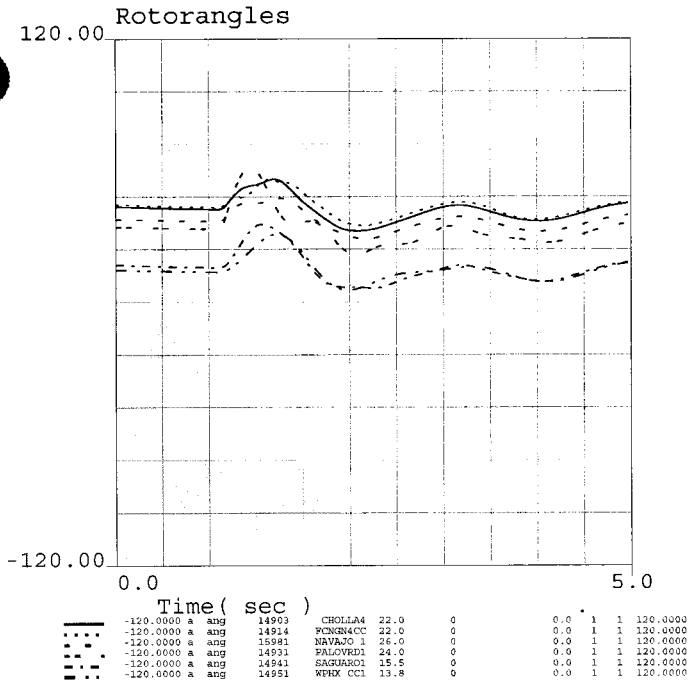

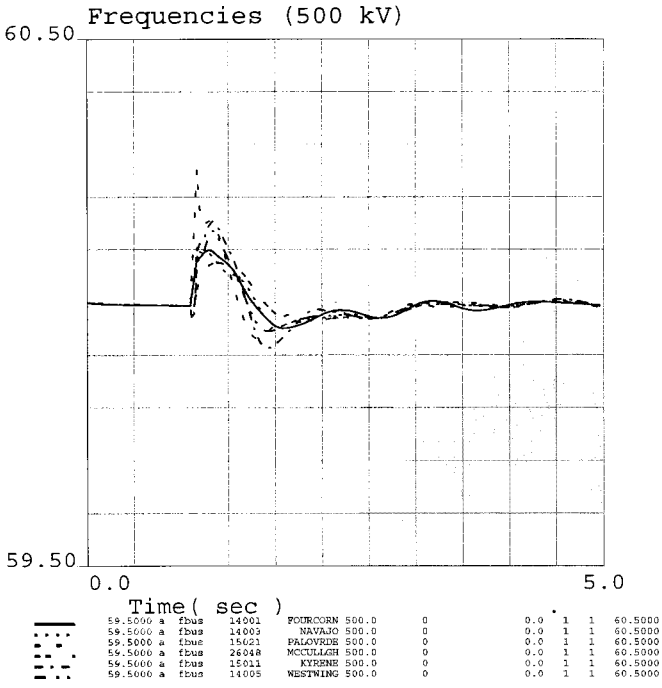

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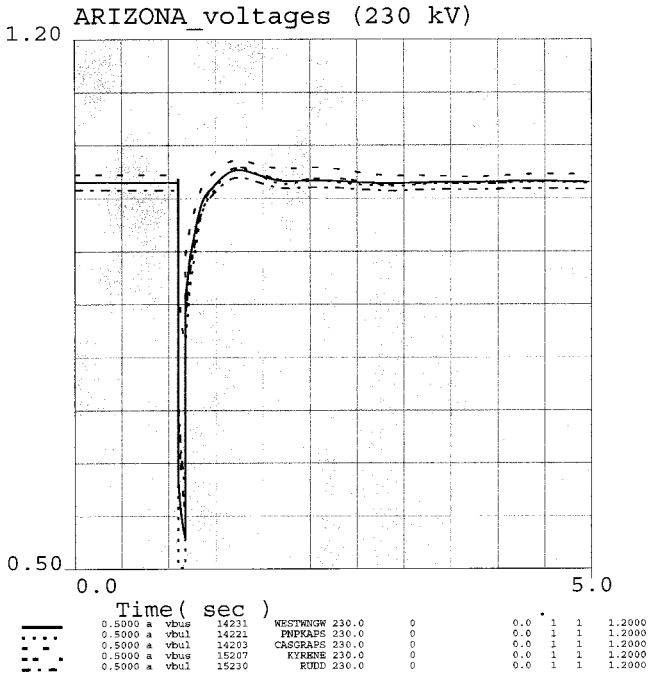

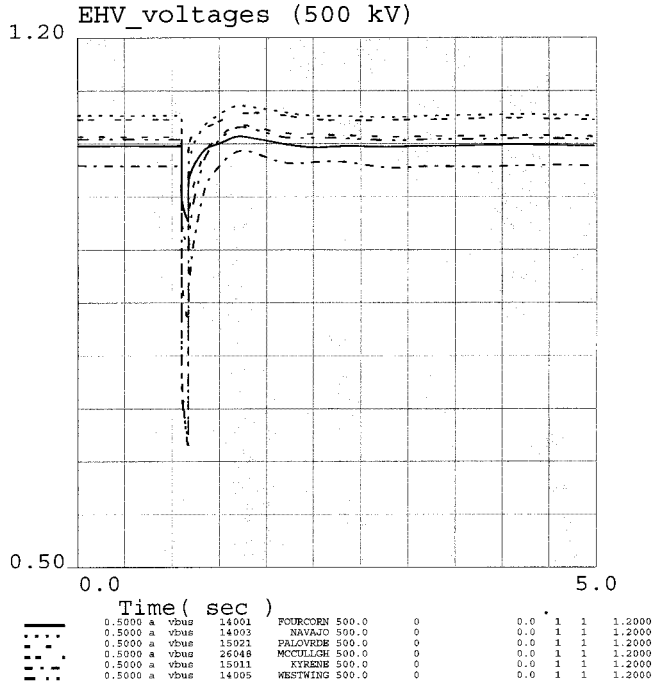

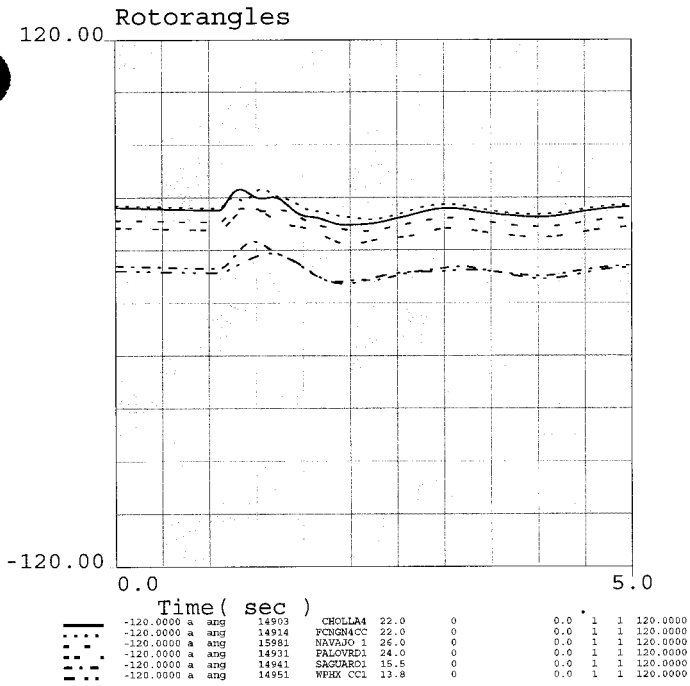

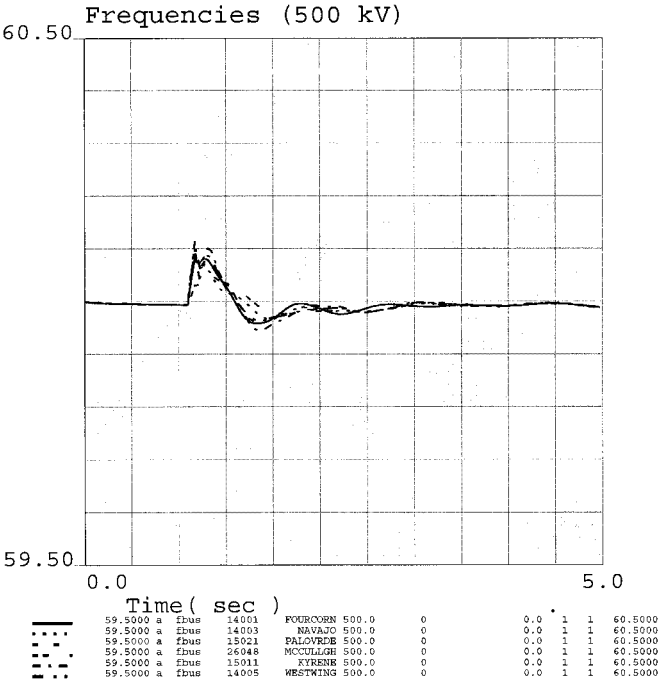

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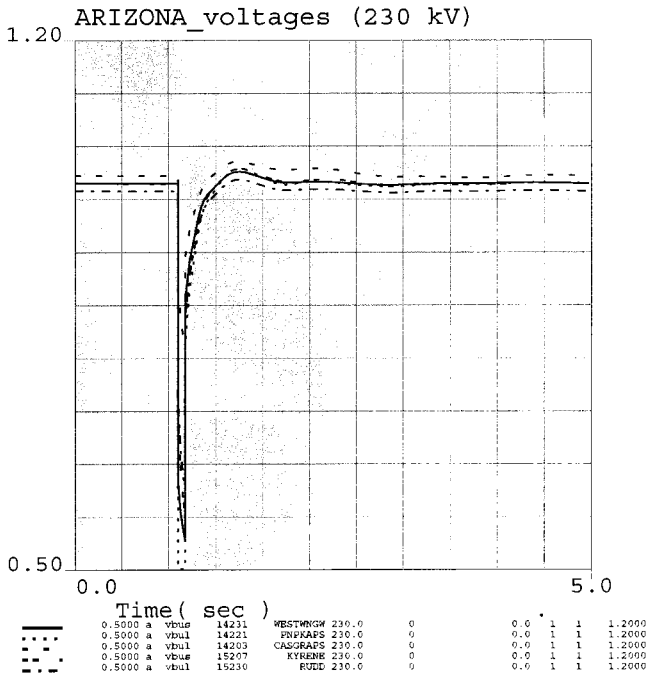

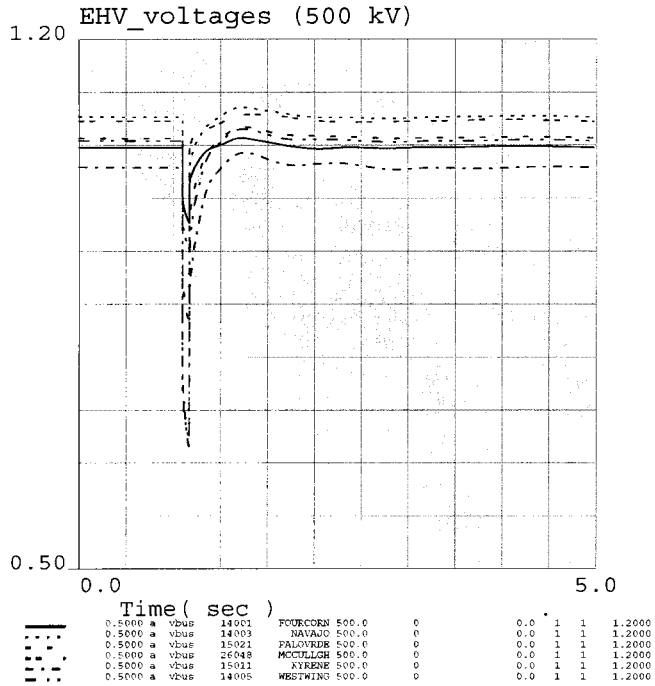

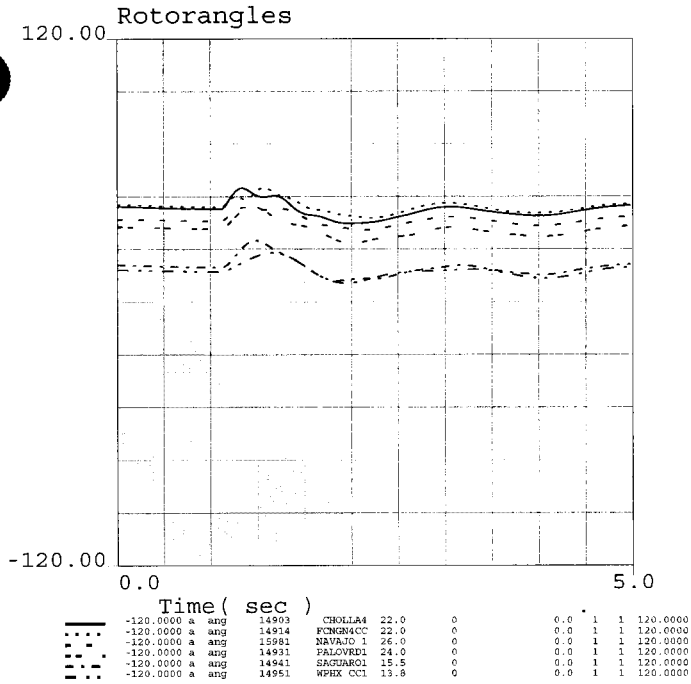

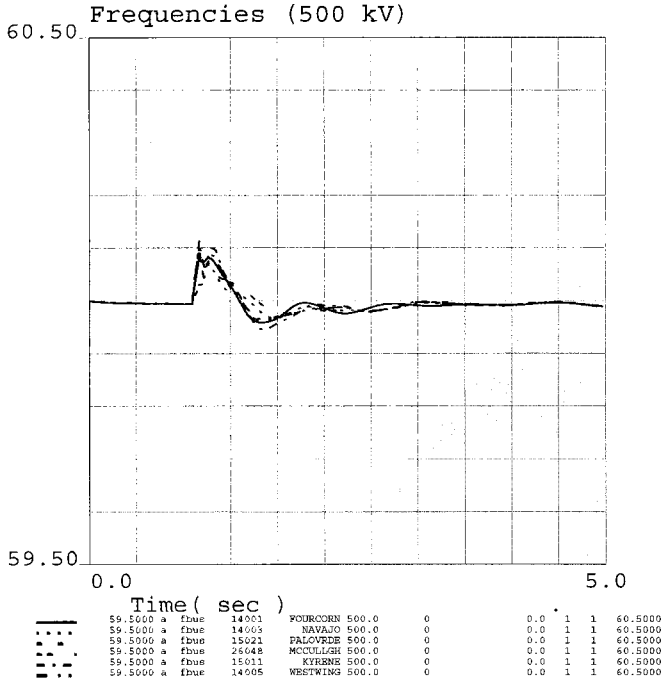

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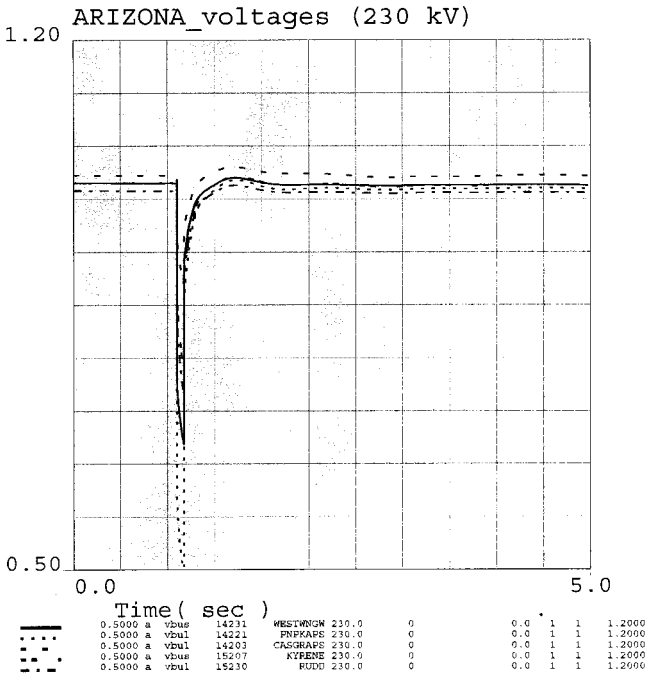

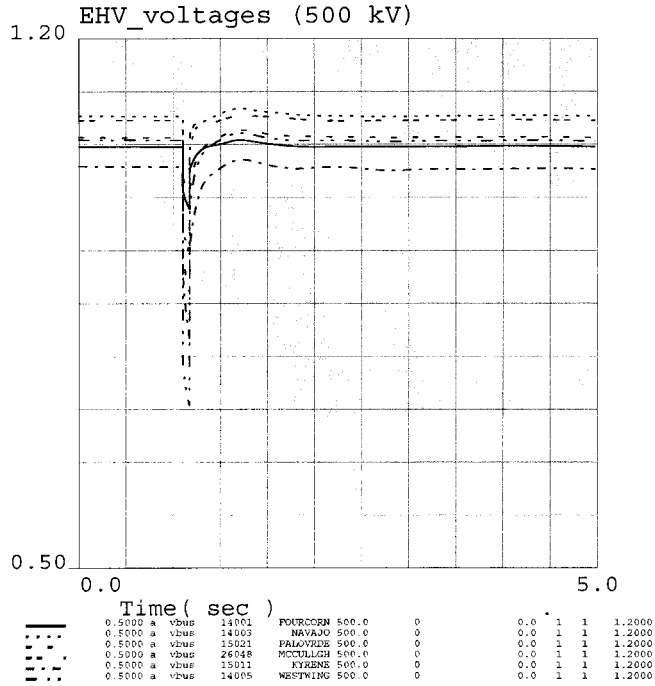

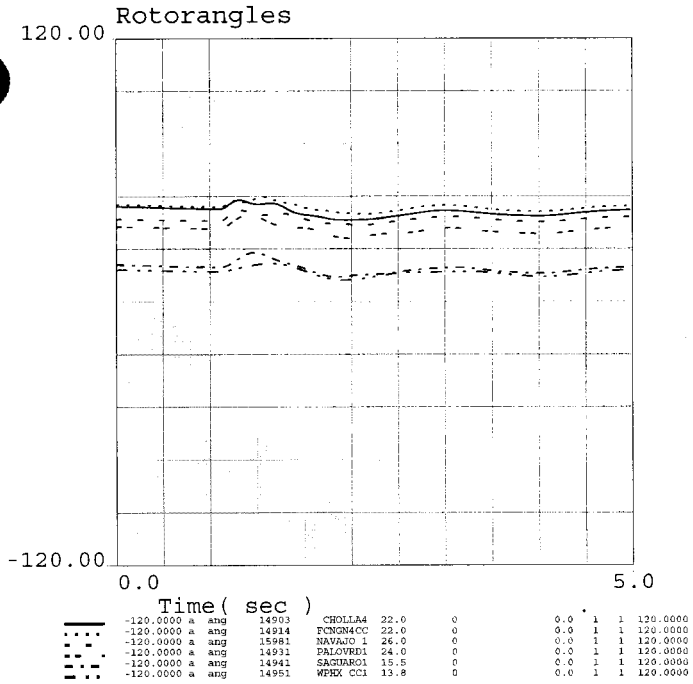

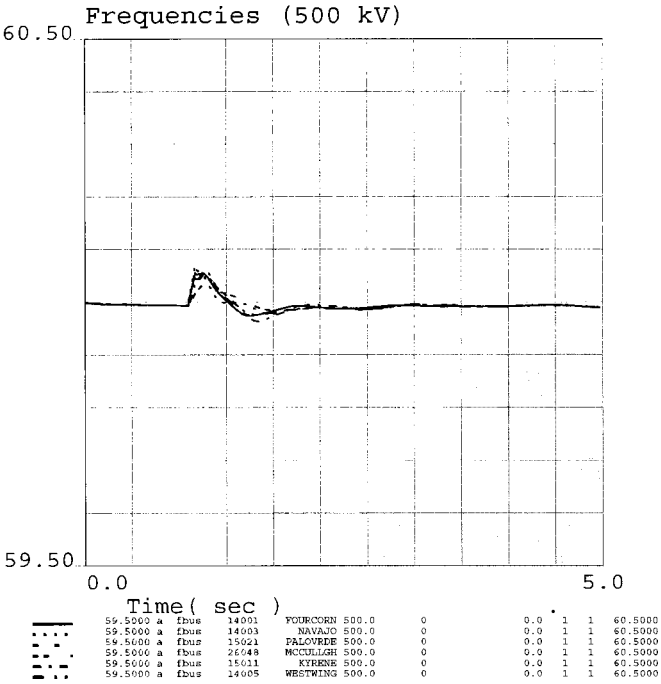

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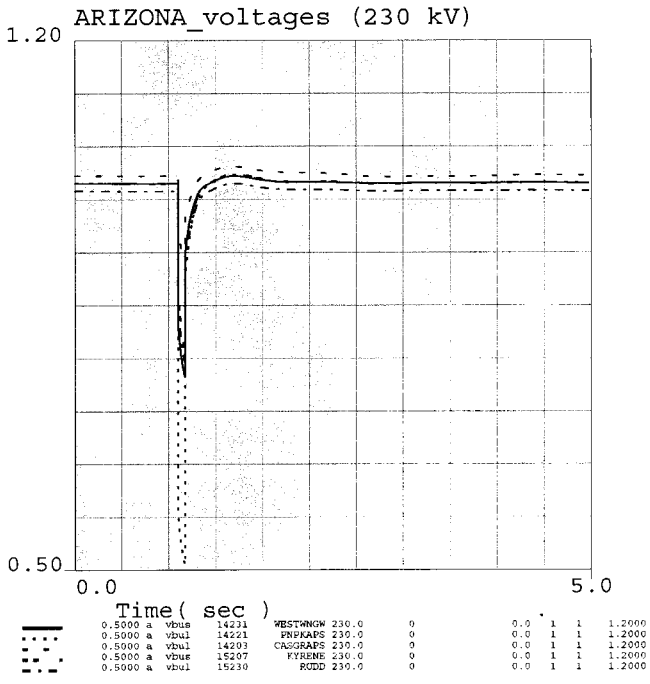

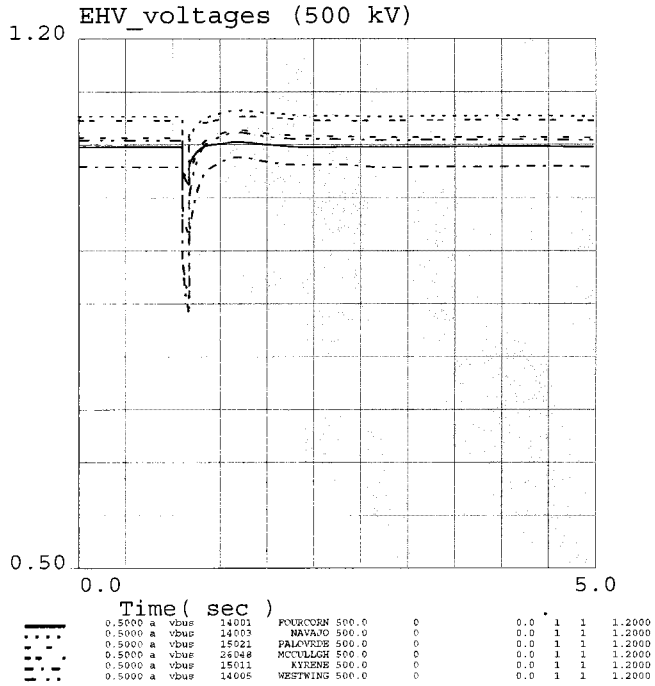

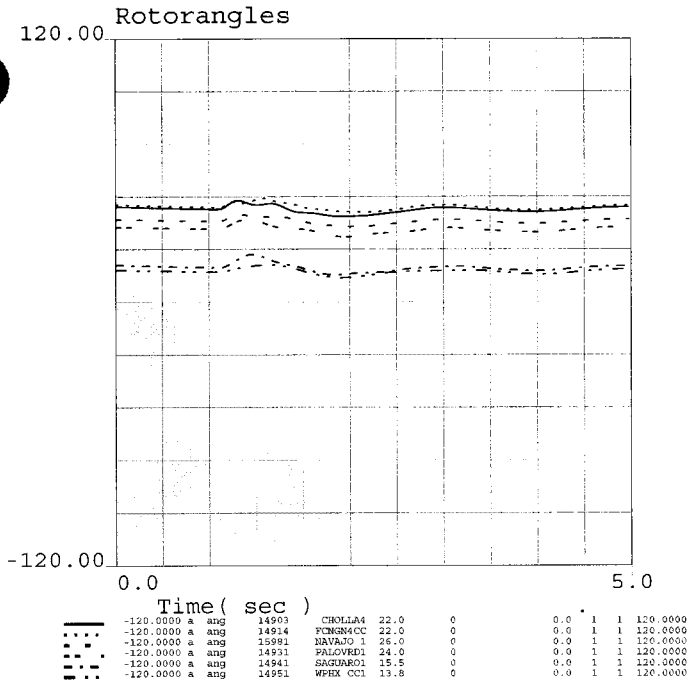

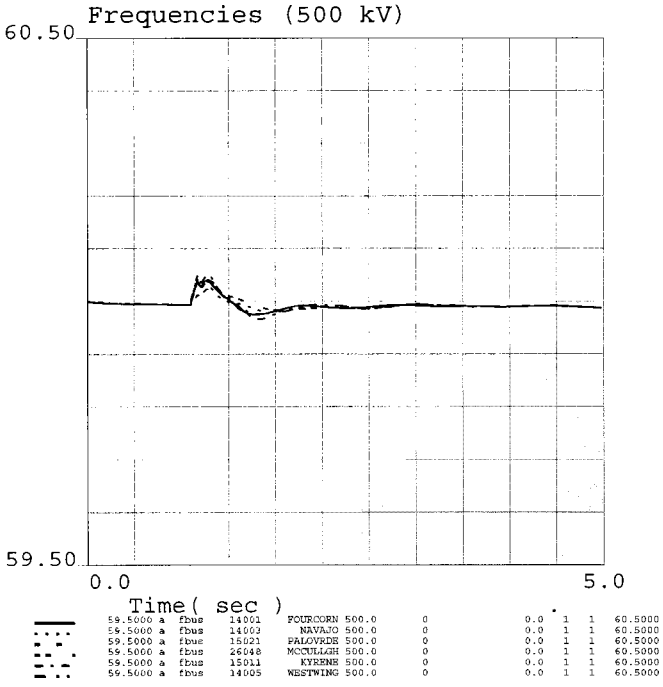

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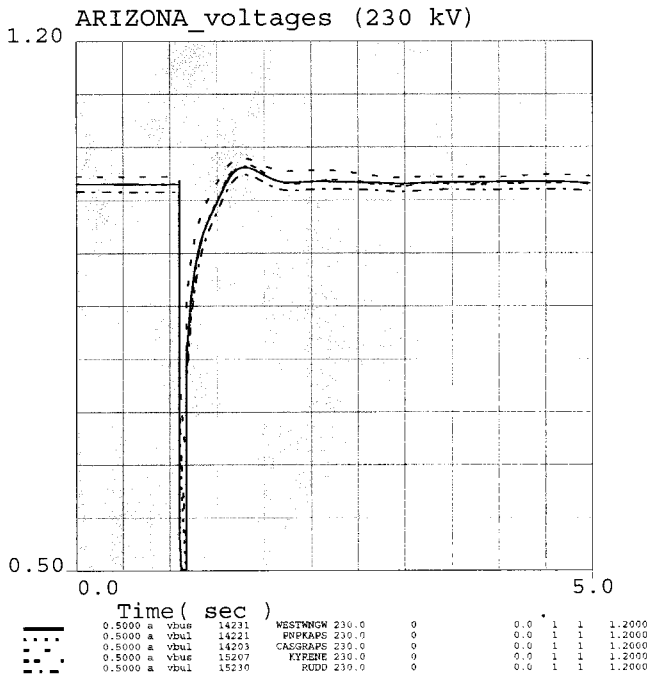

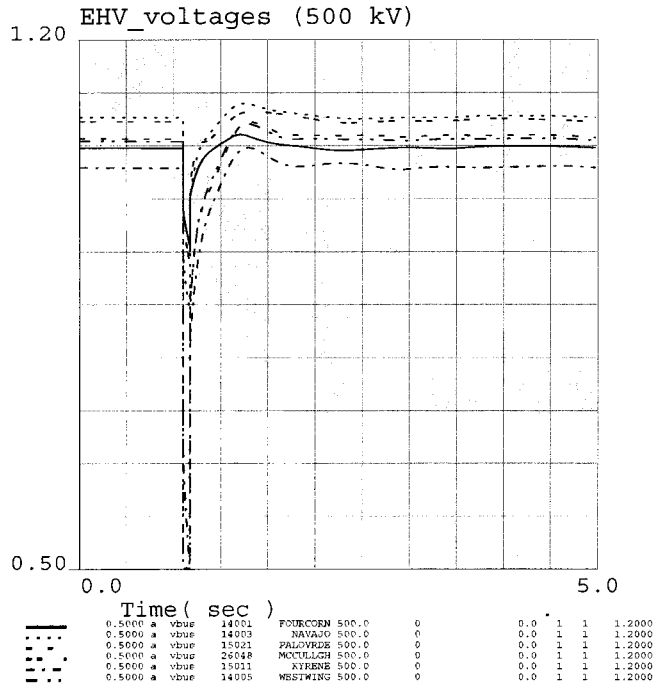

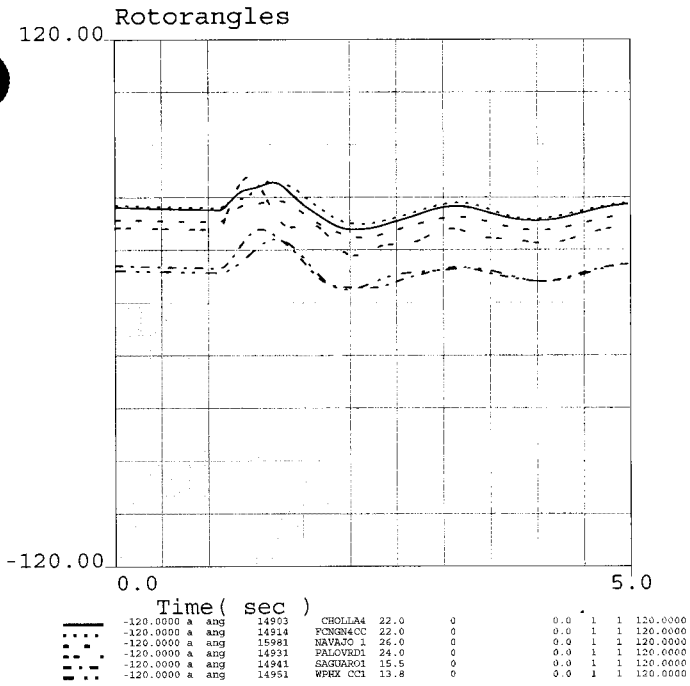

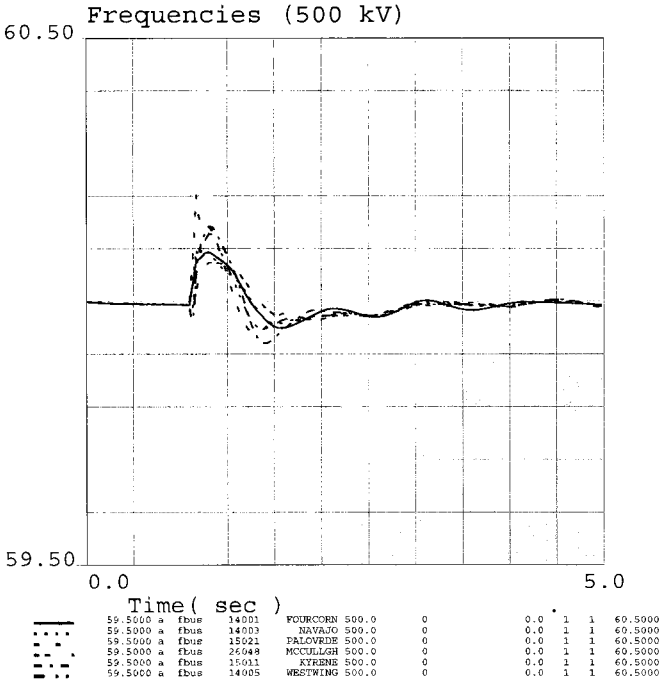

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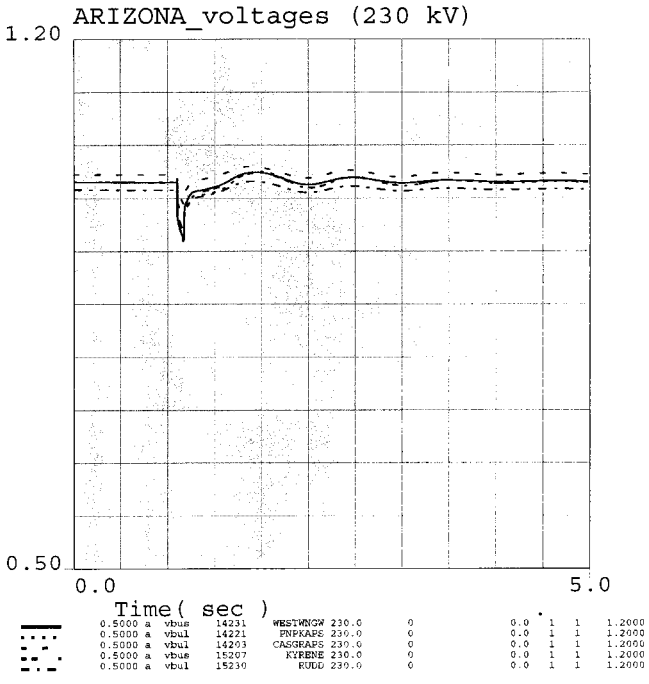

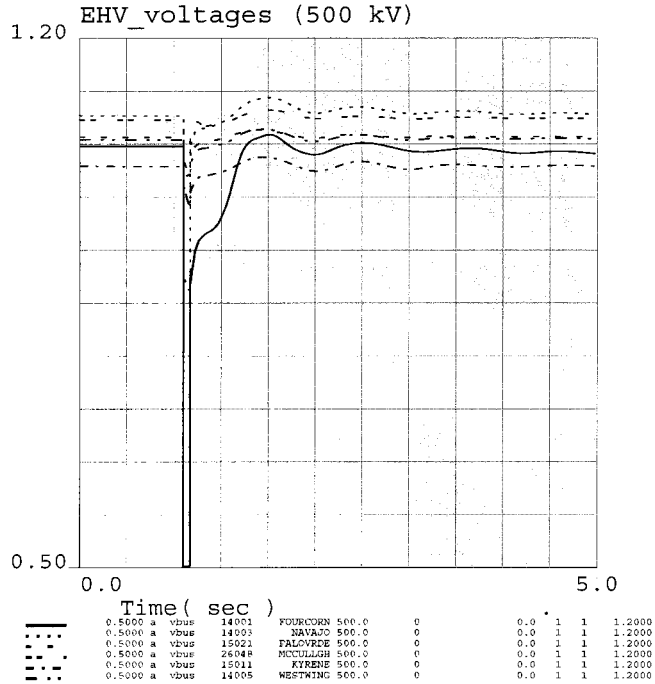

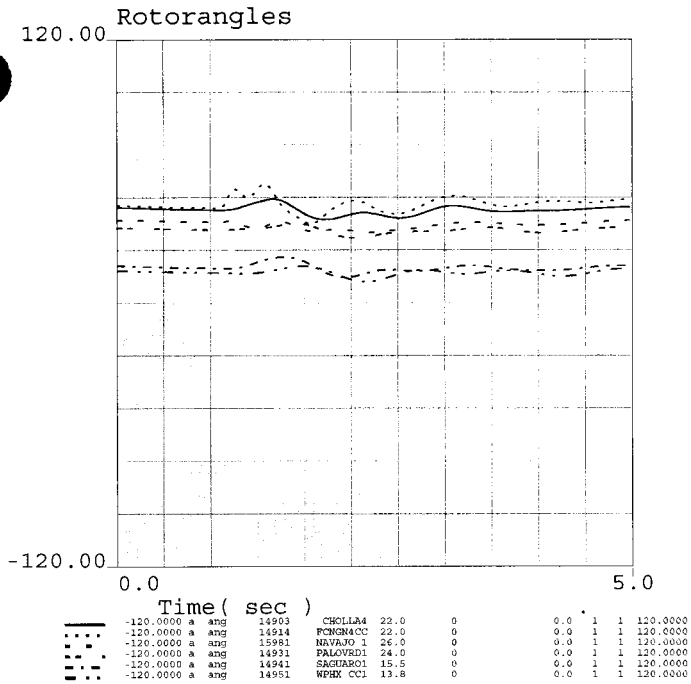

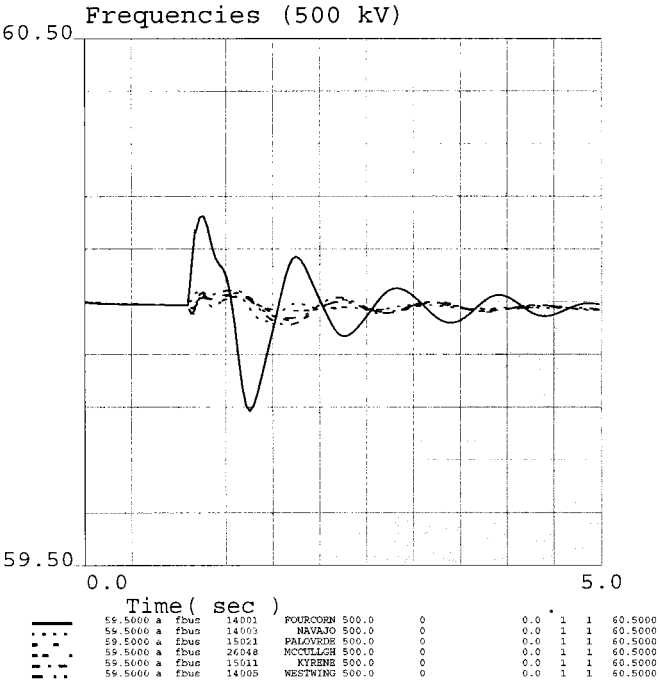

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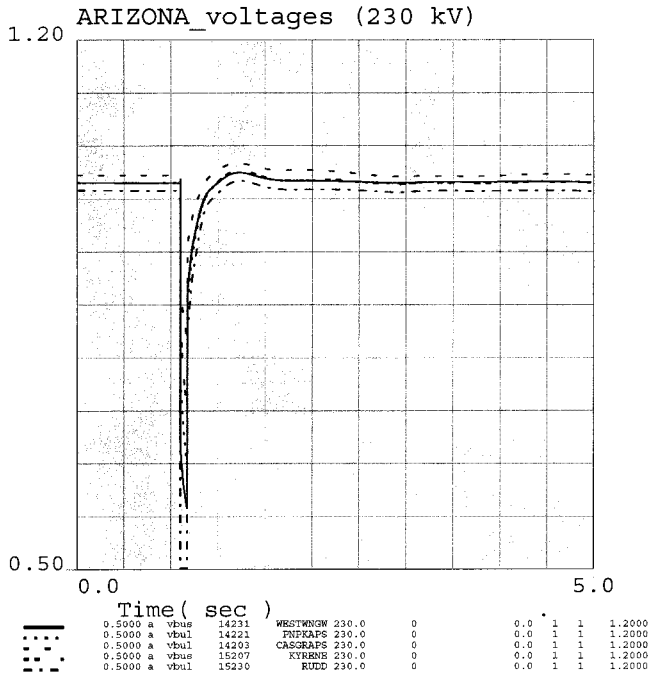

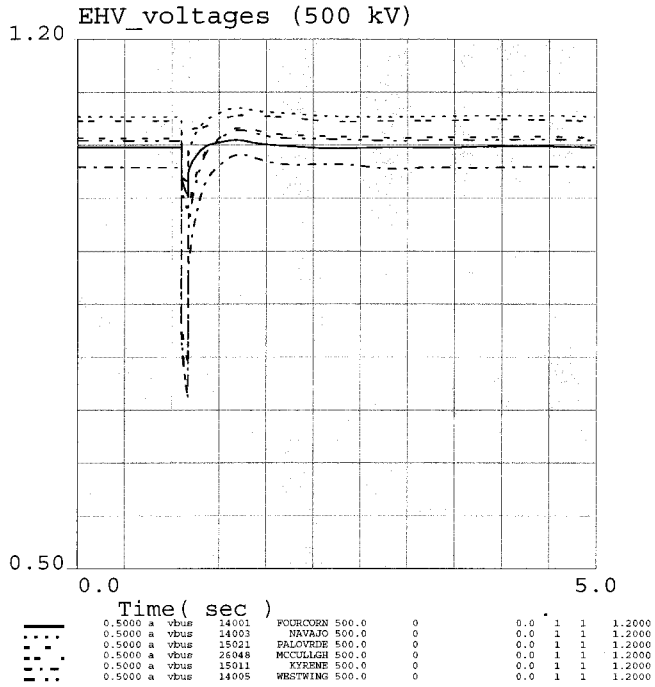

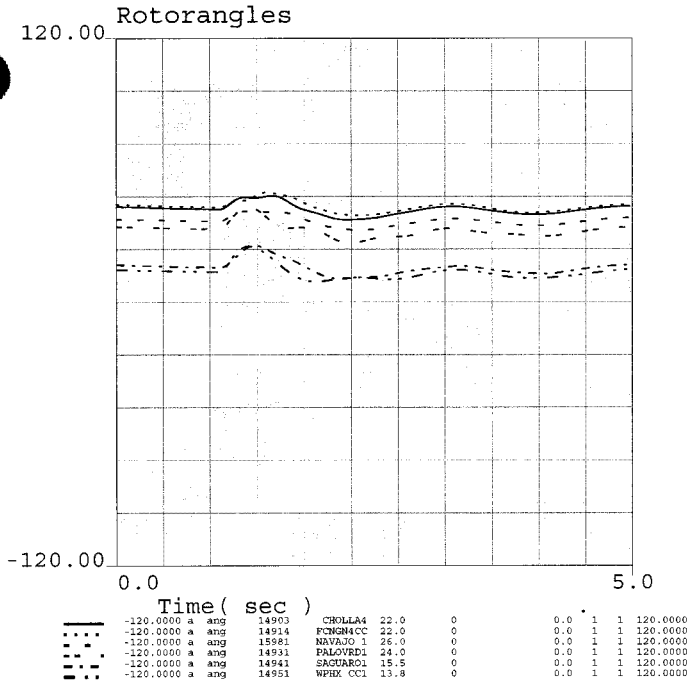

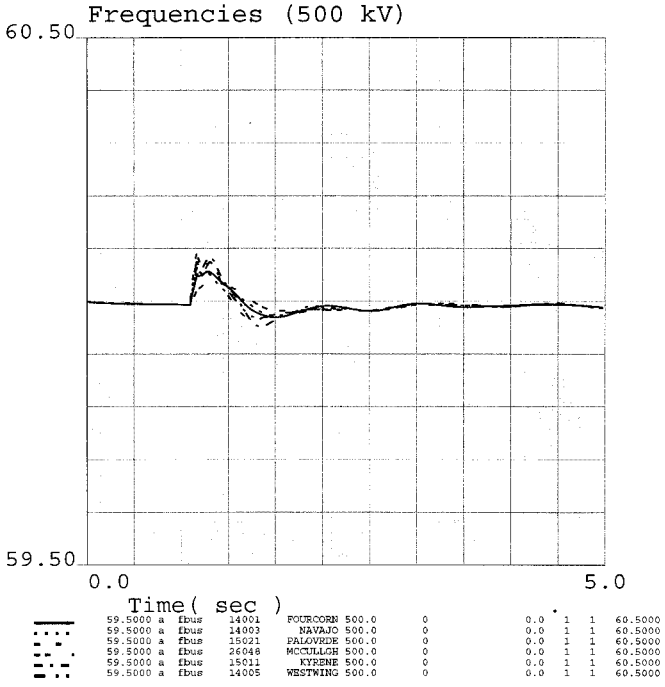

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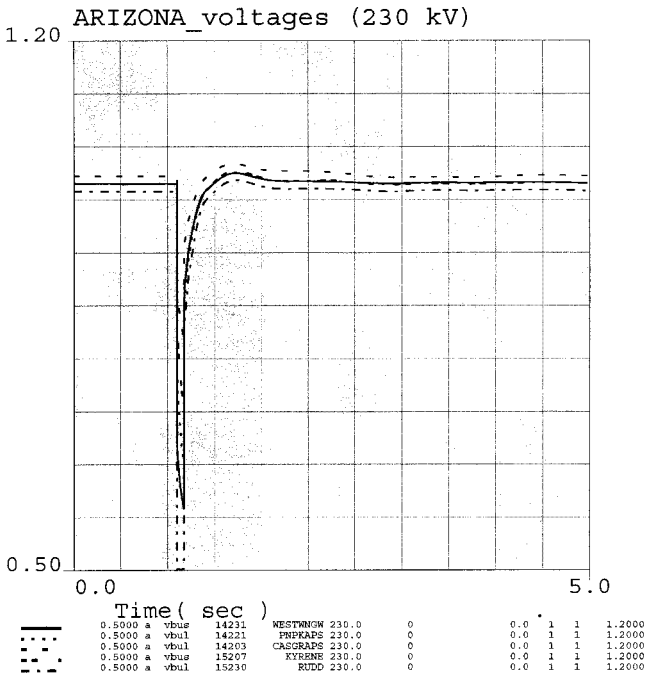
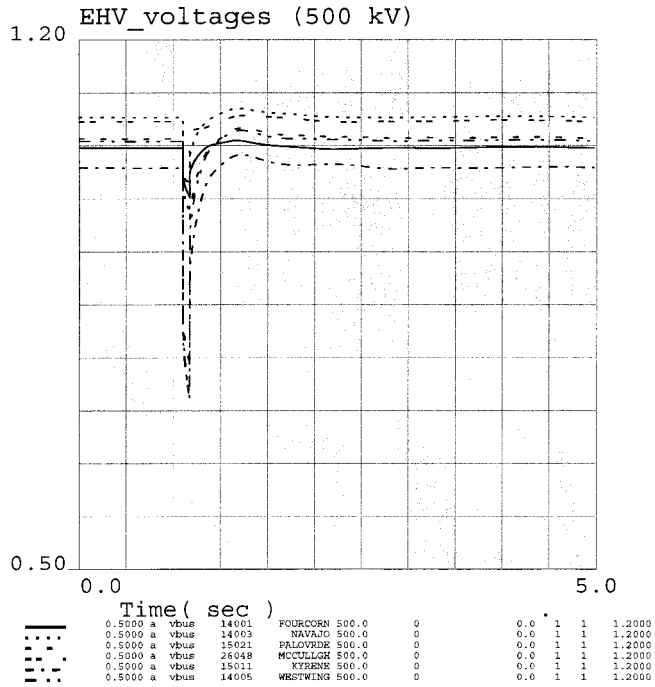
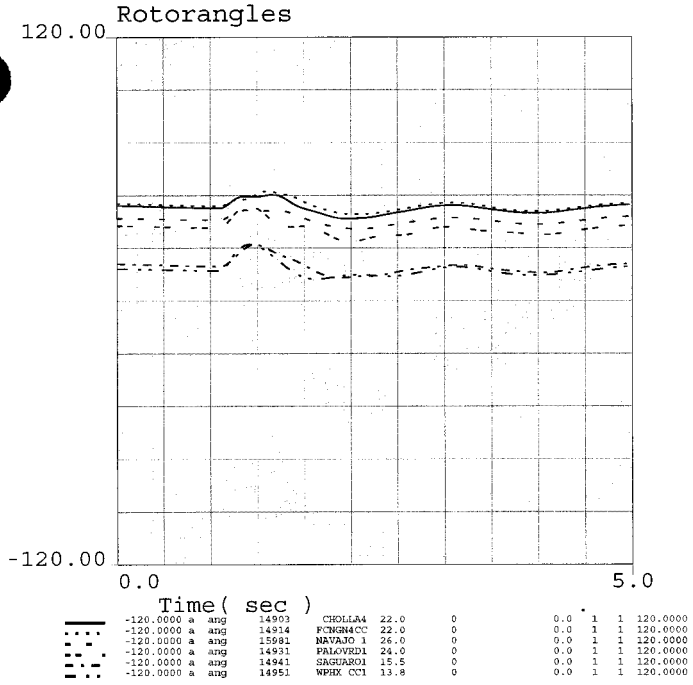
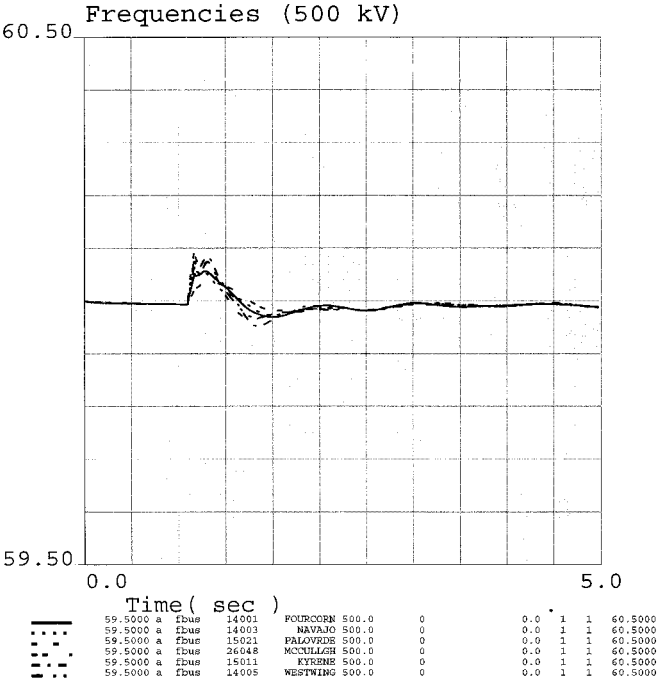
2009 APS Ten Year Plan
2018 Heavy Summer WECC/WestConnect Case









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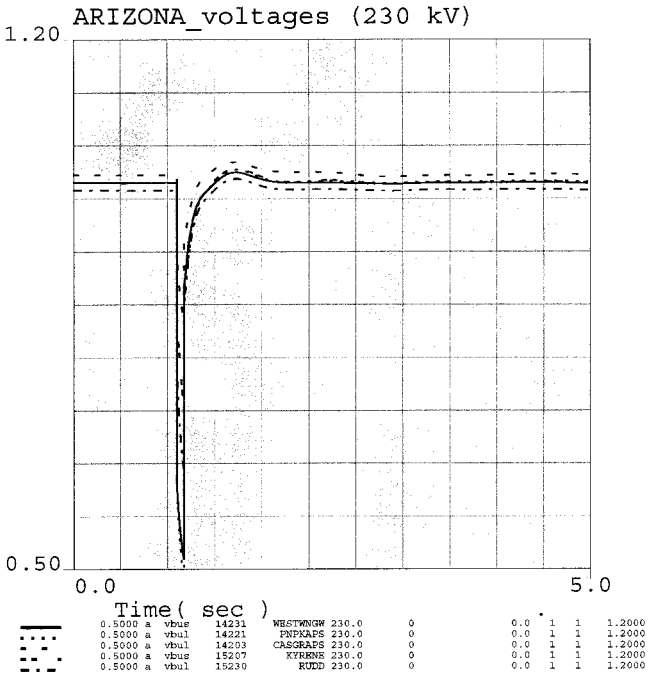

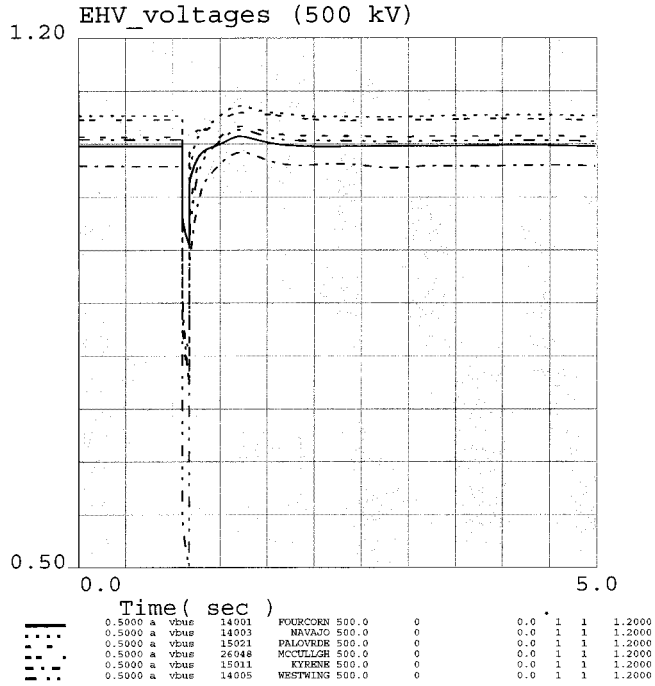

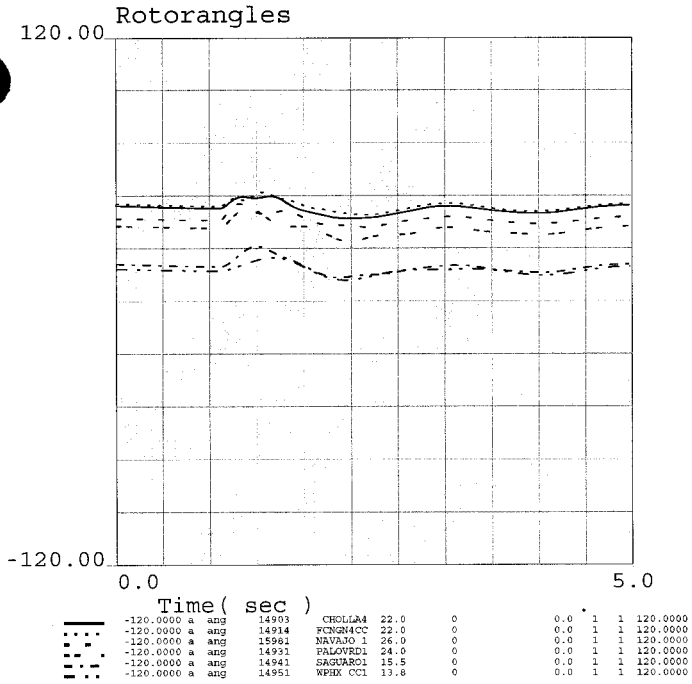

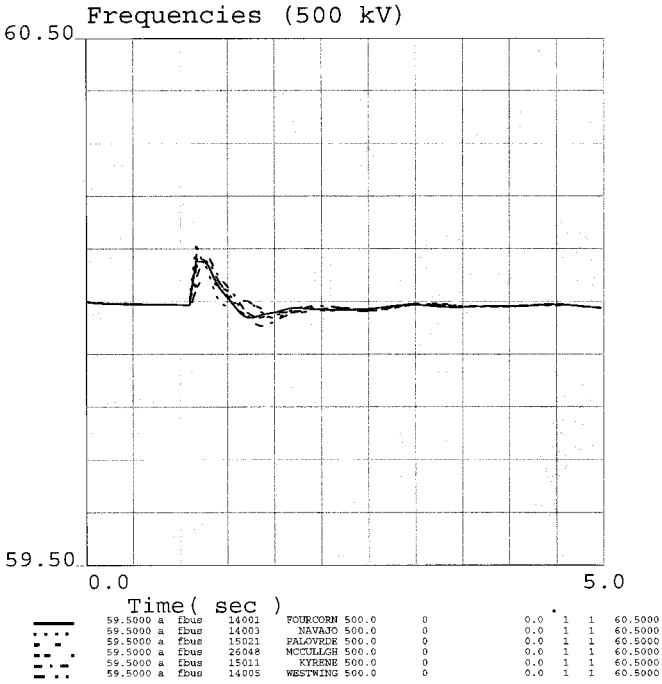

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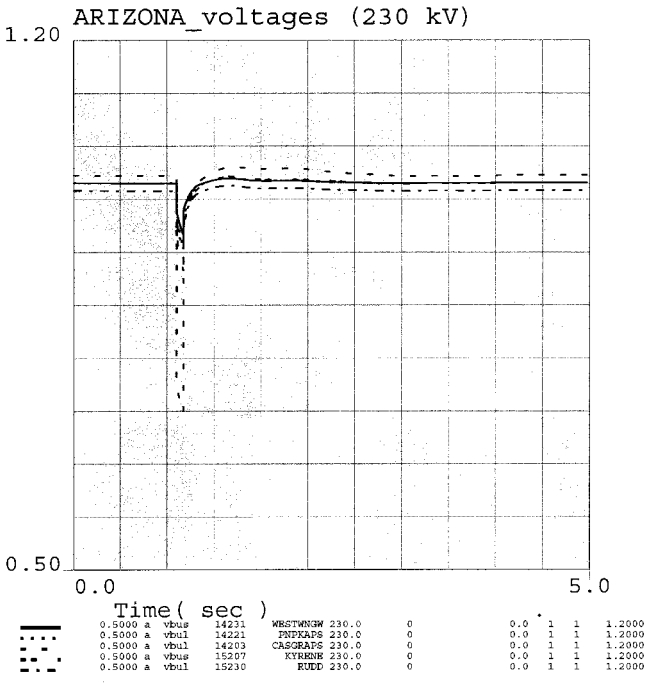

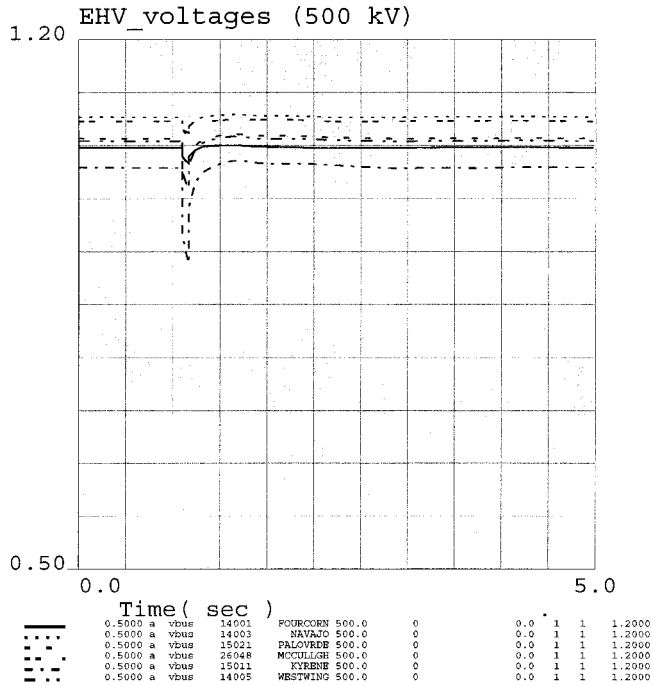

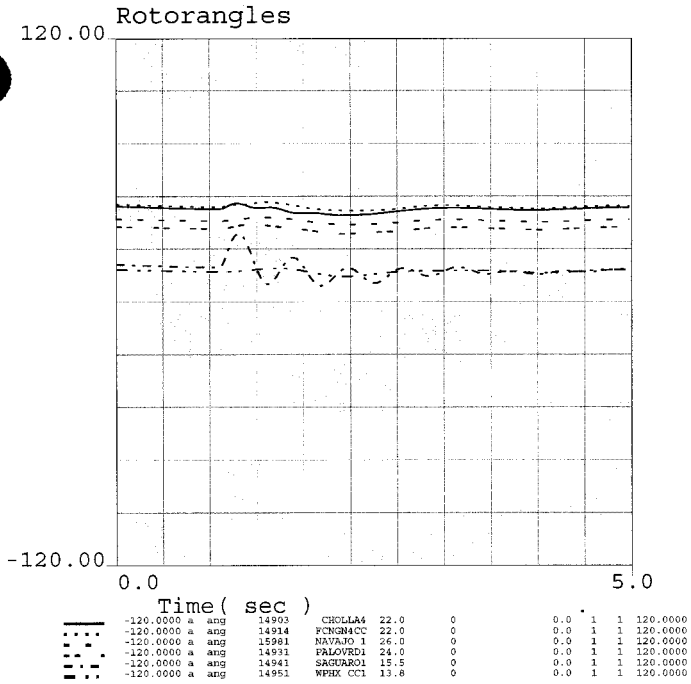

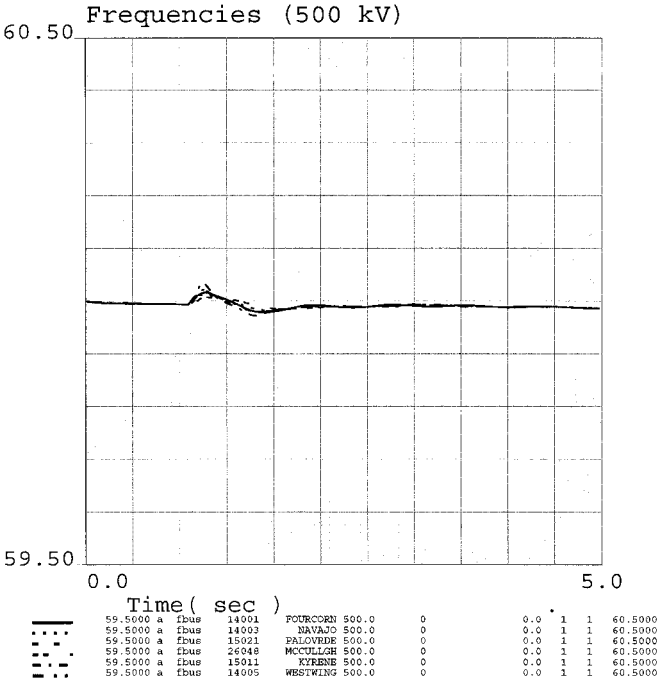

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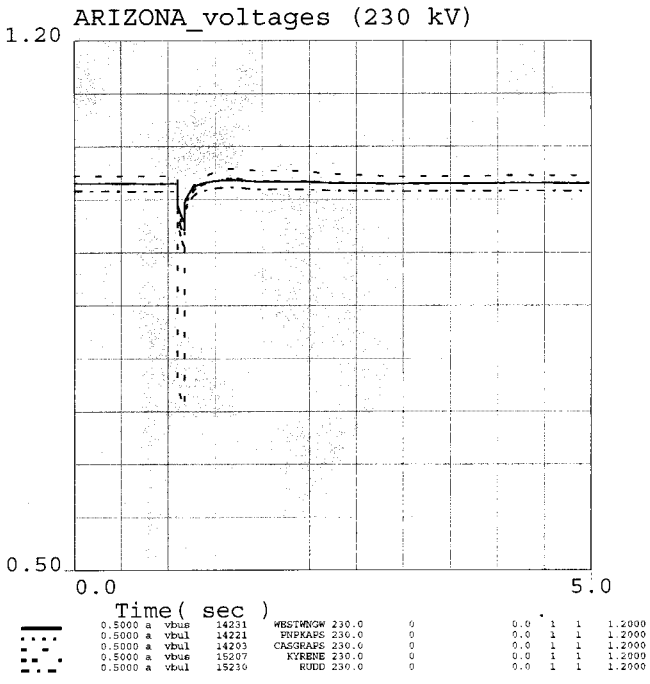

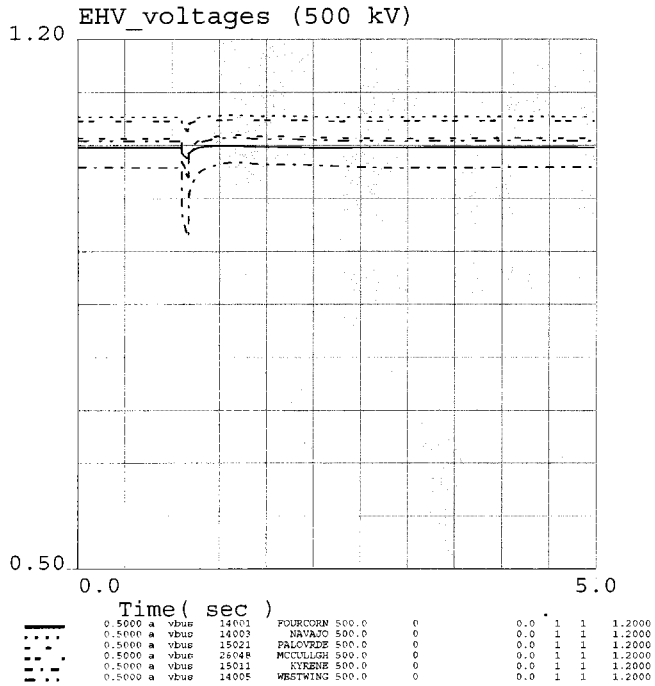

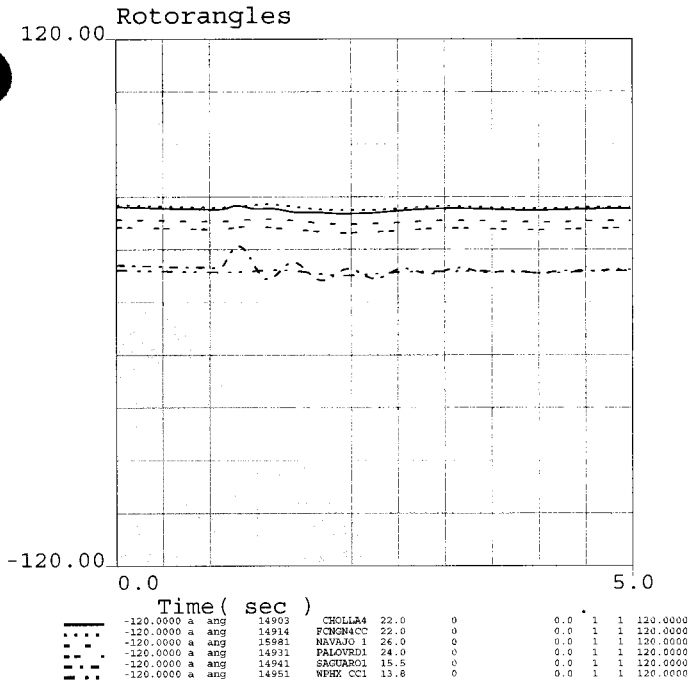

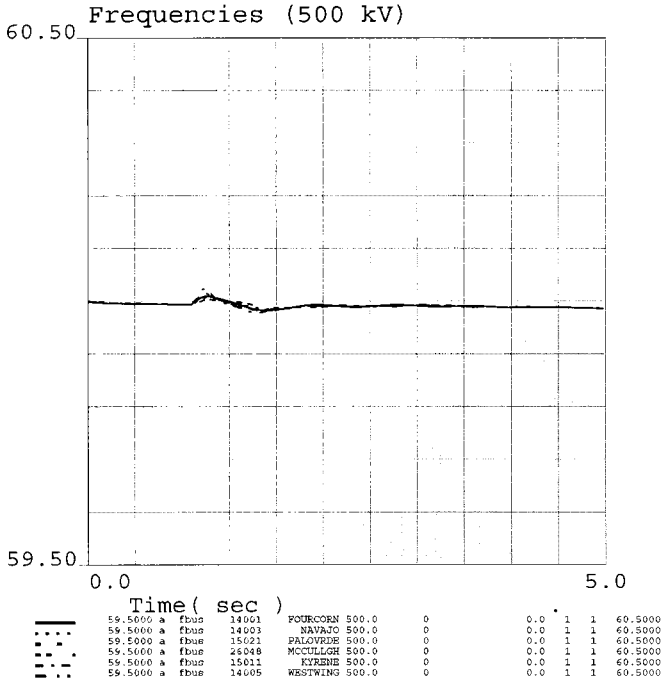

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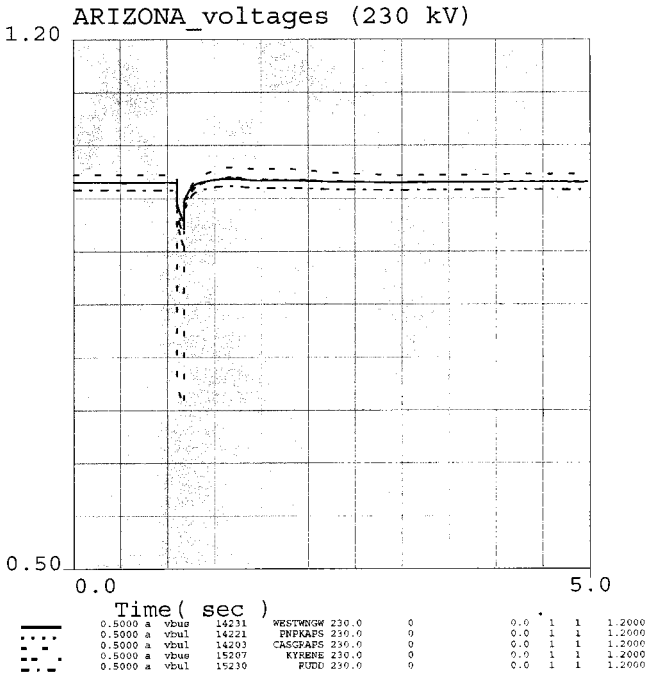

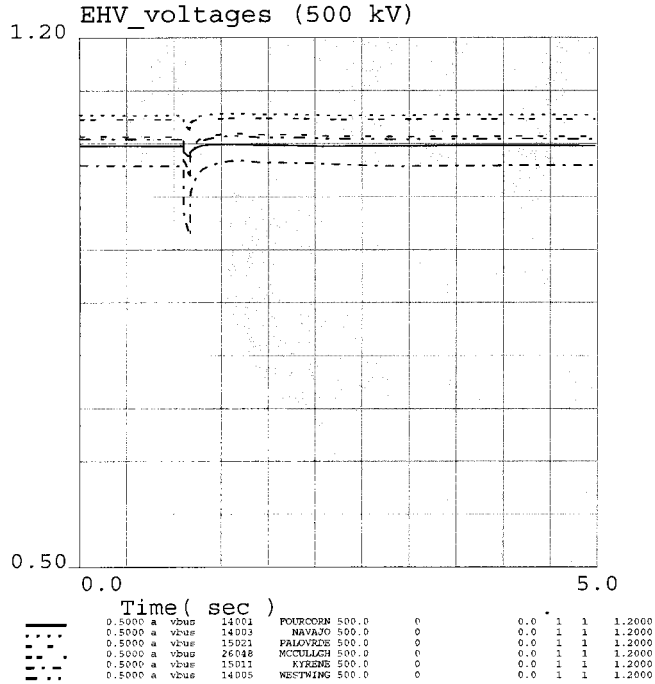

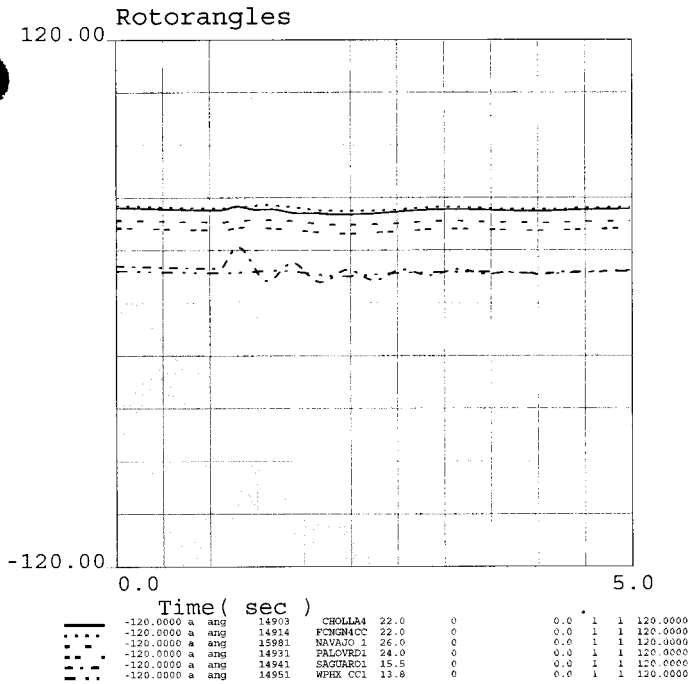

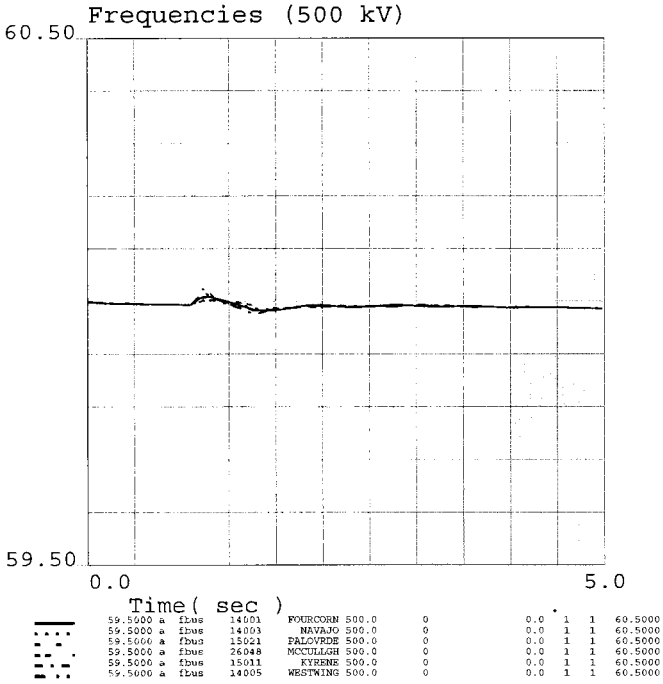

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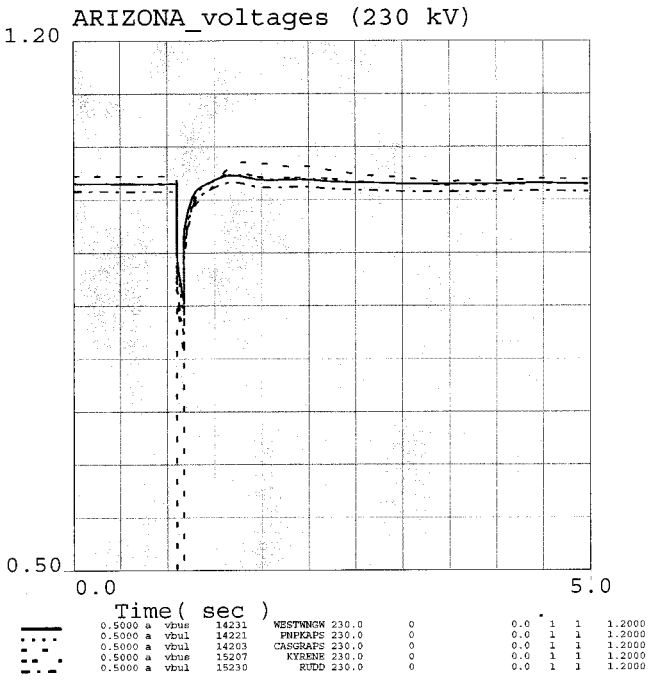

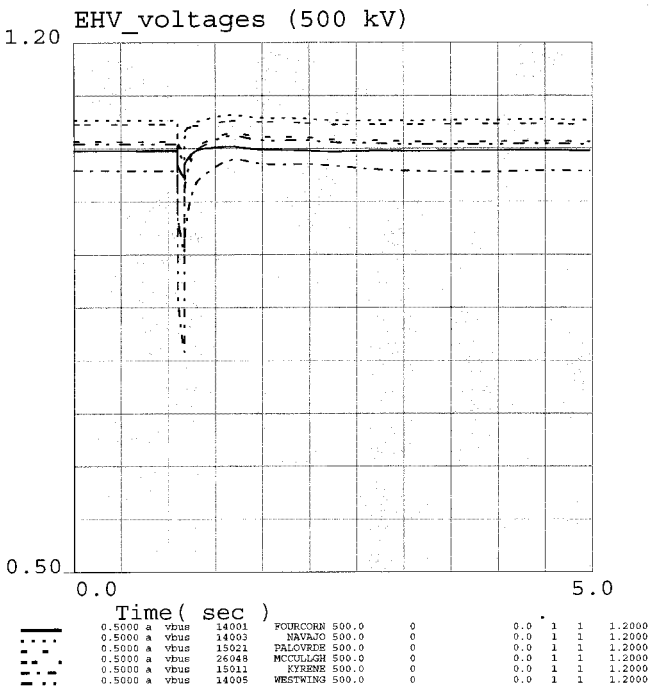

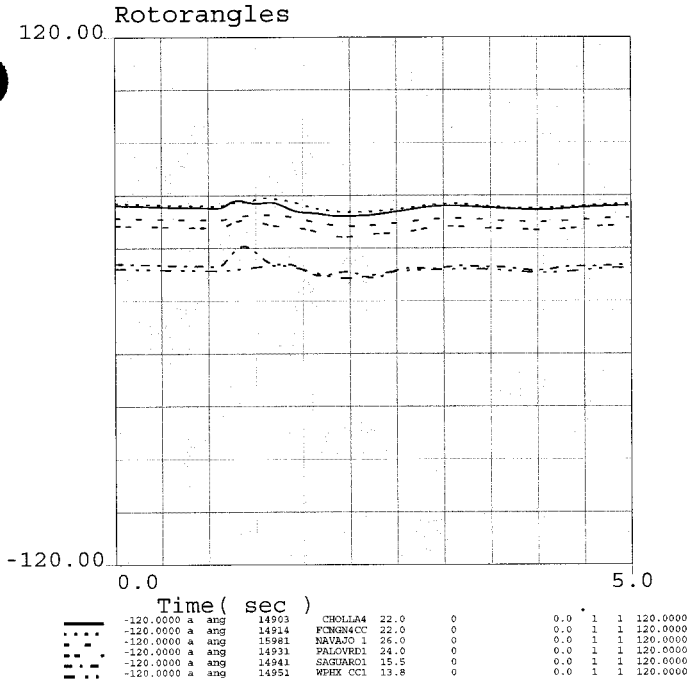

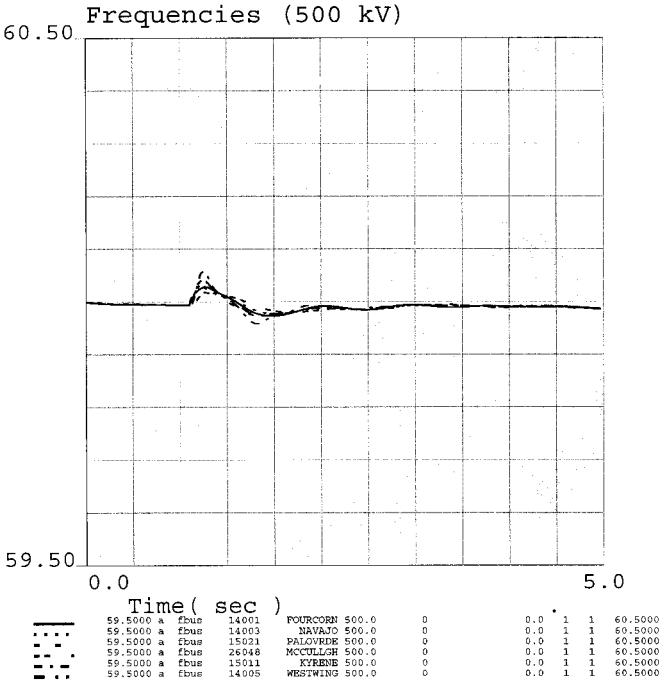

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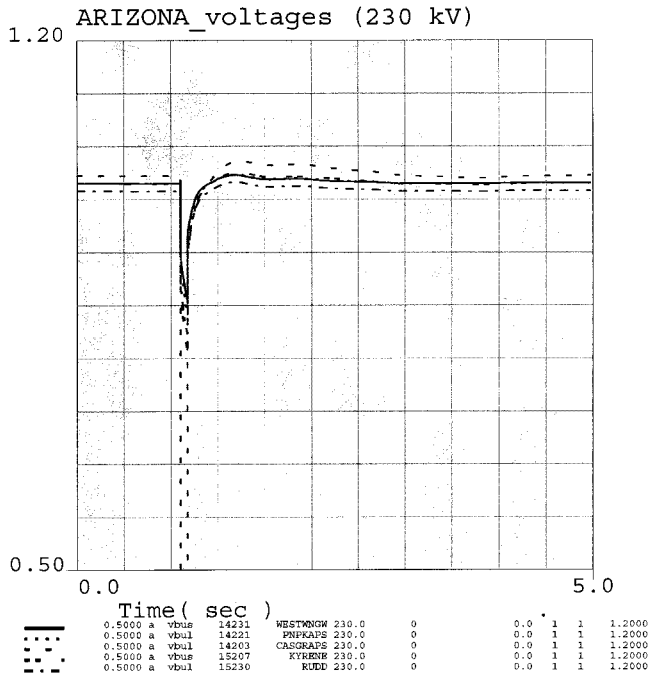

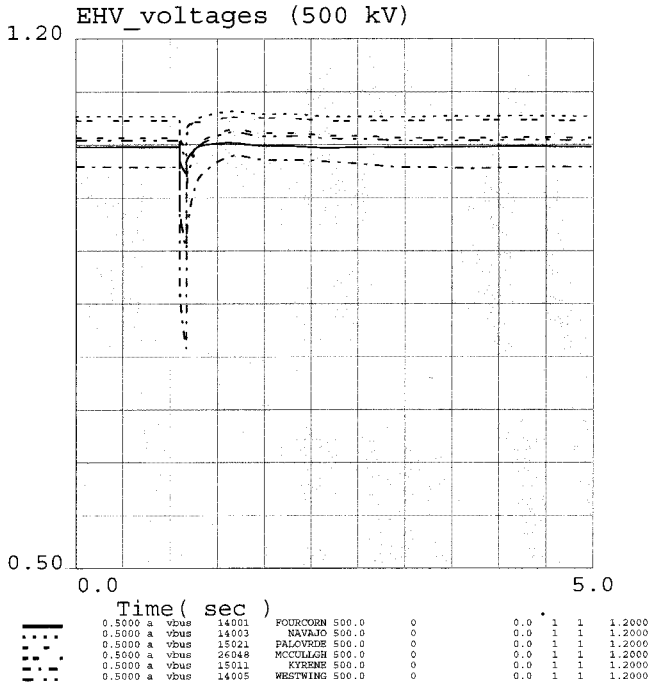

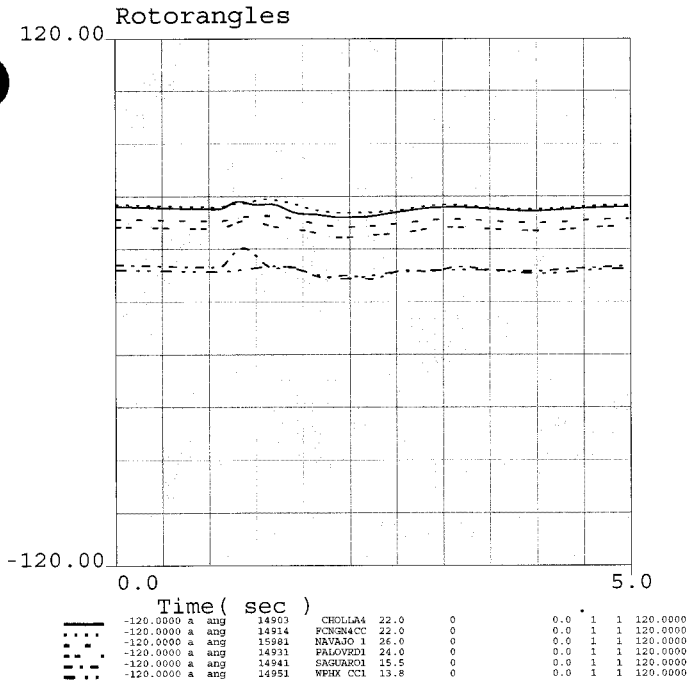

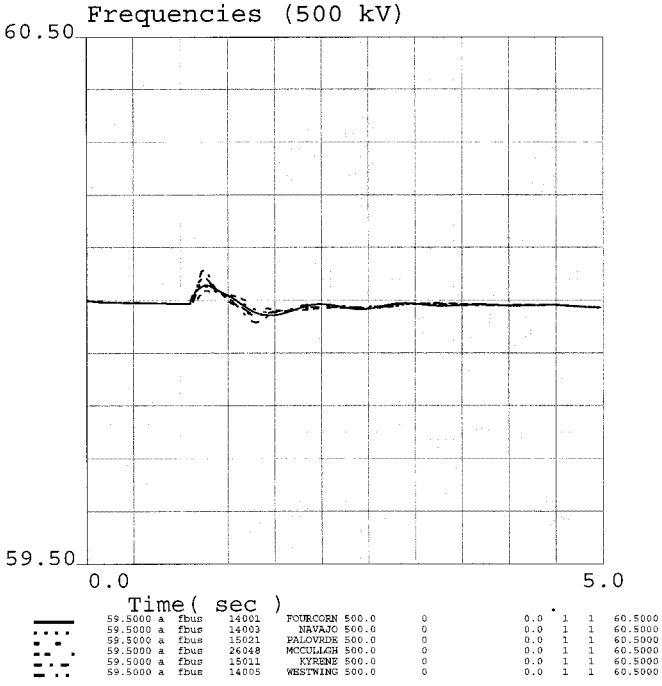

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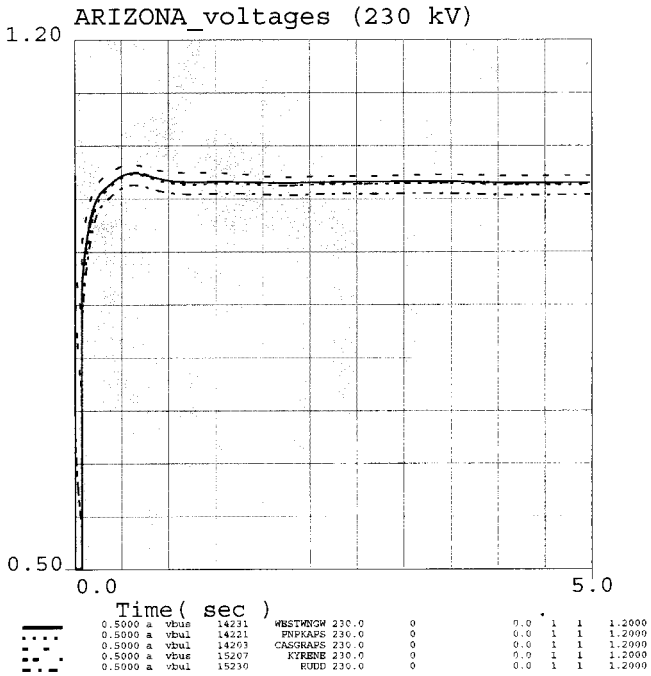

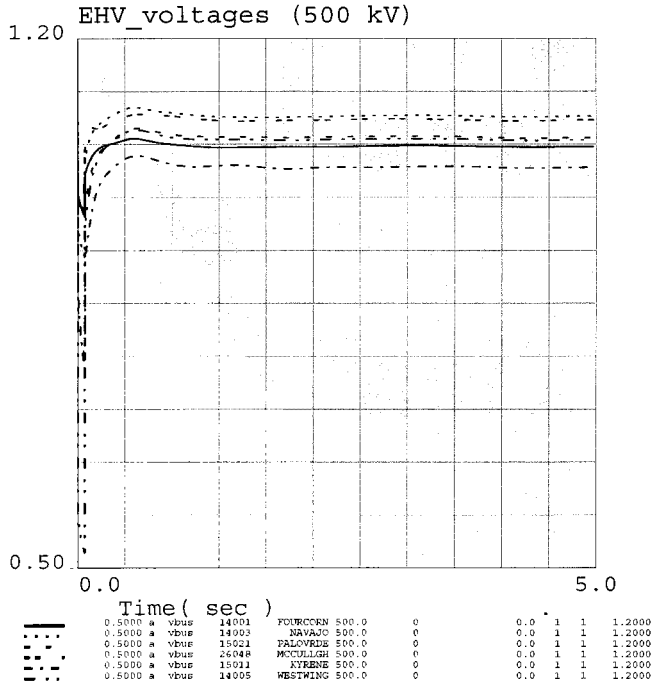

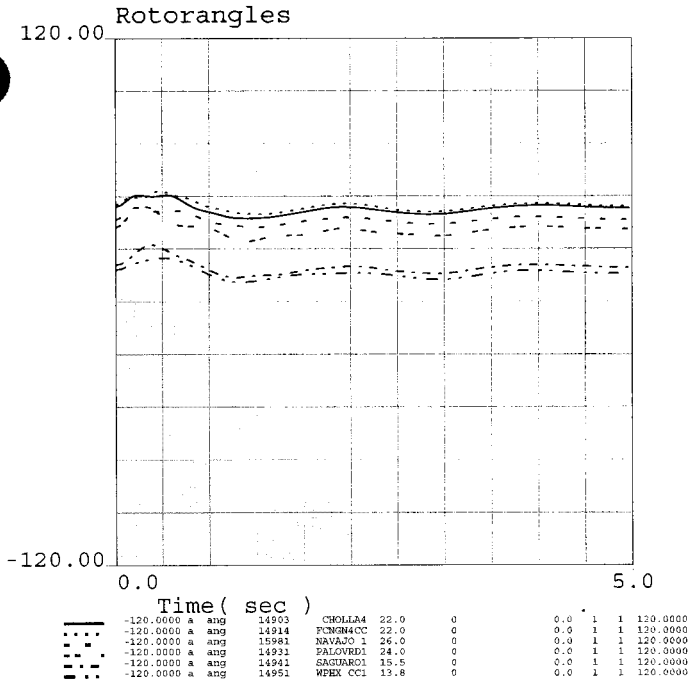

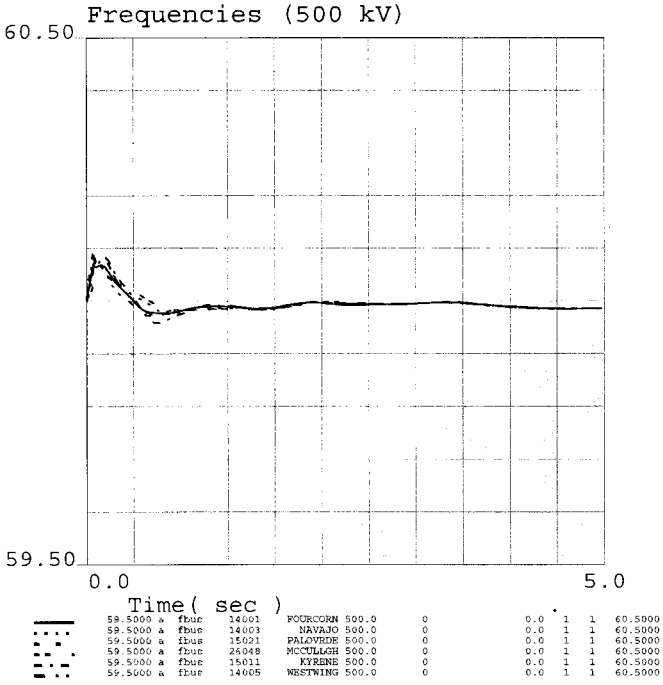

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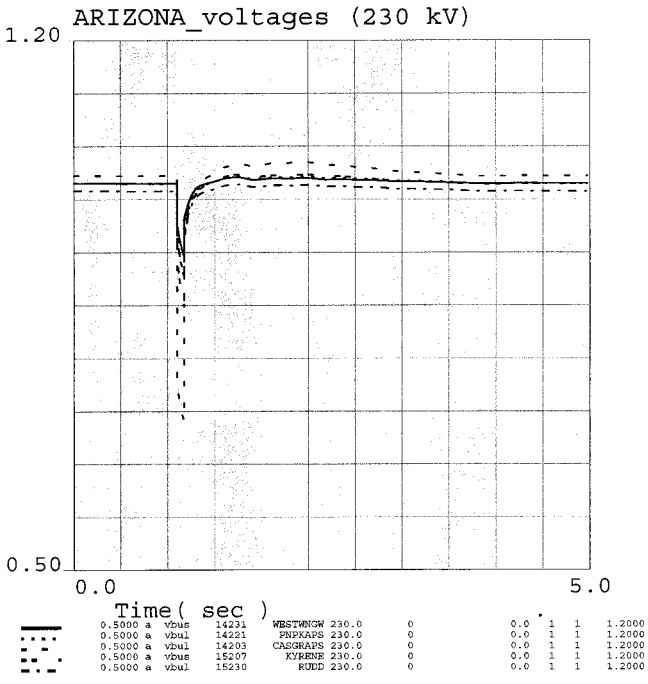

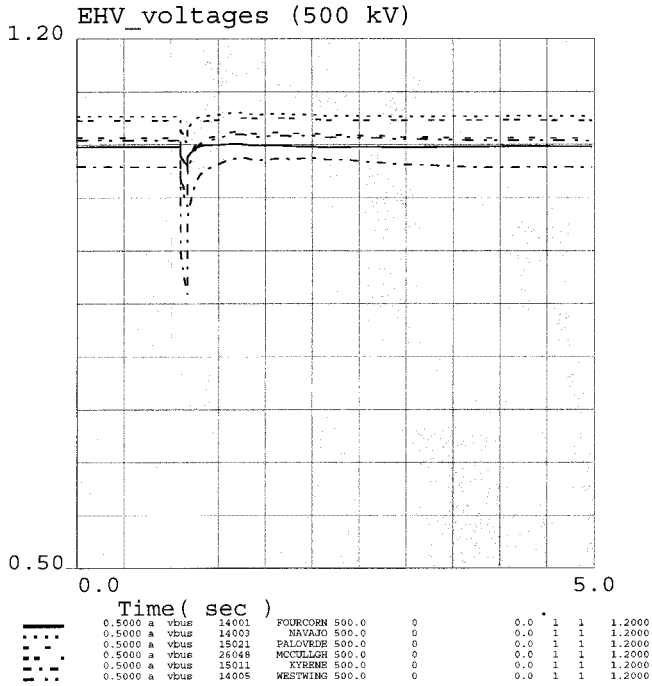

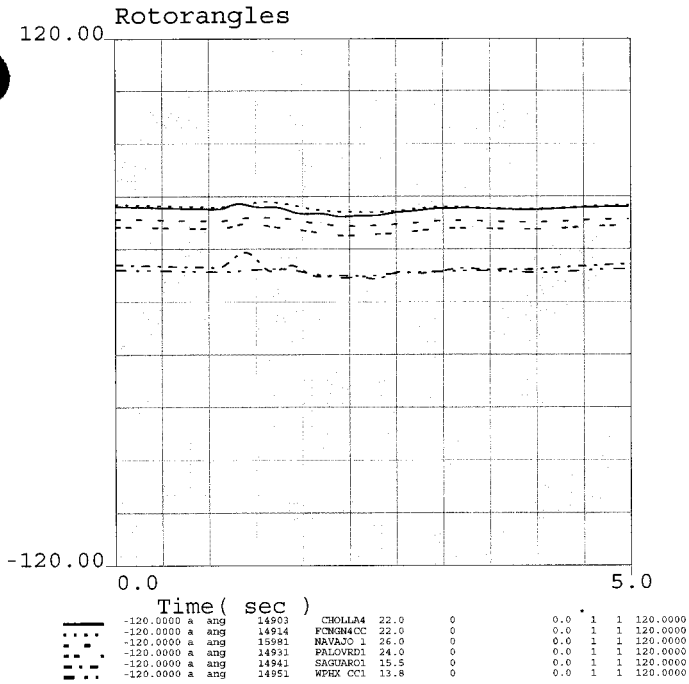

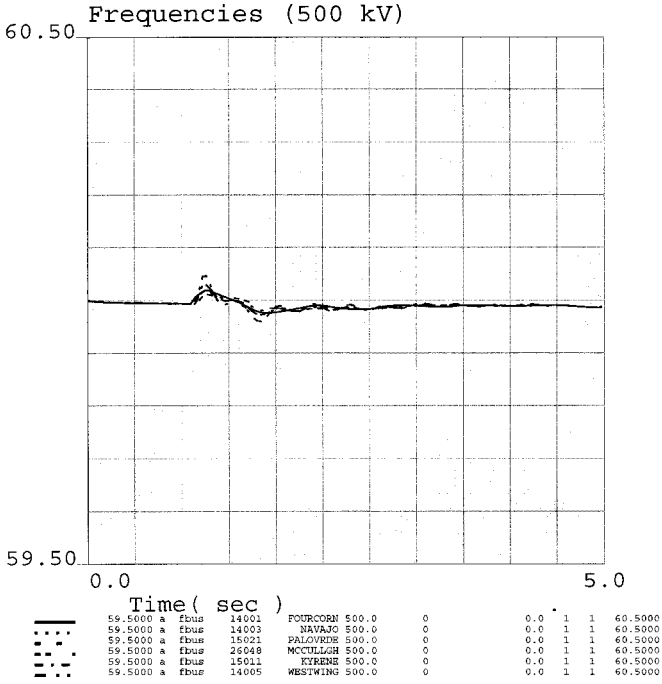

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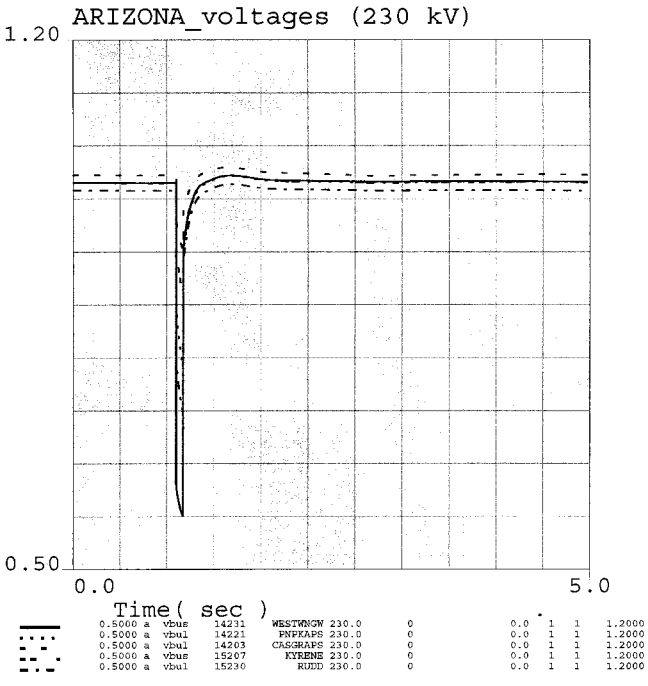

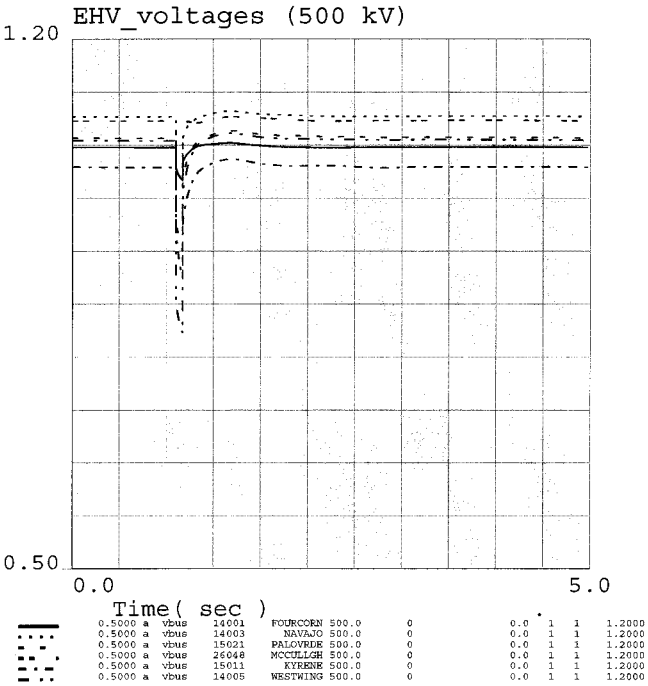

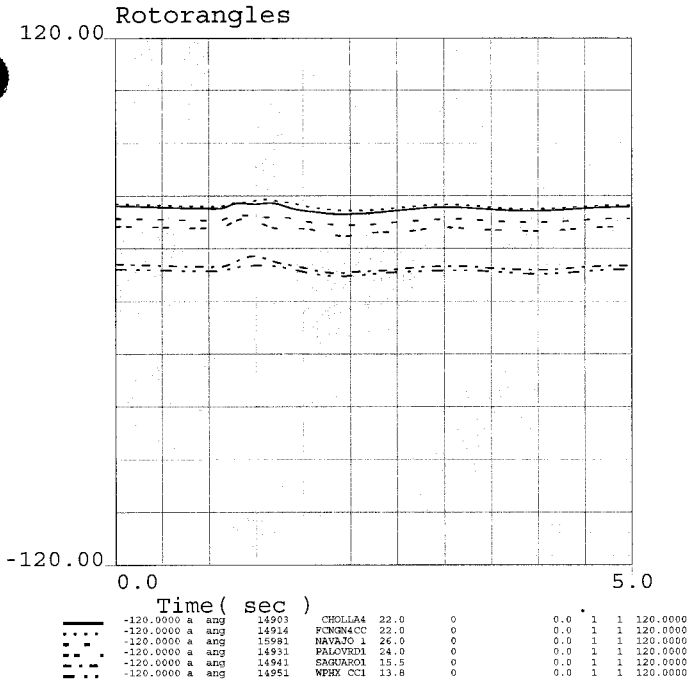

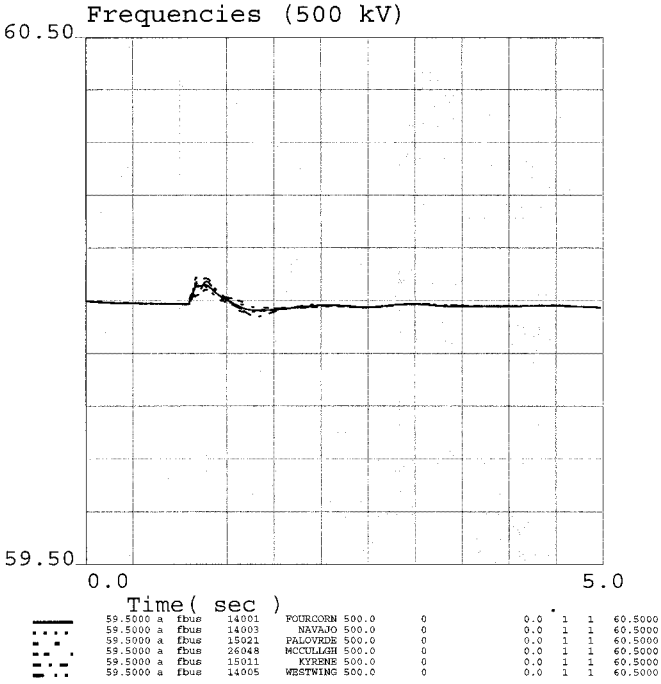

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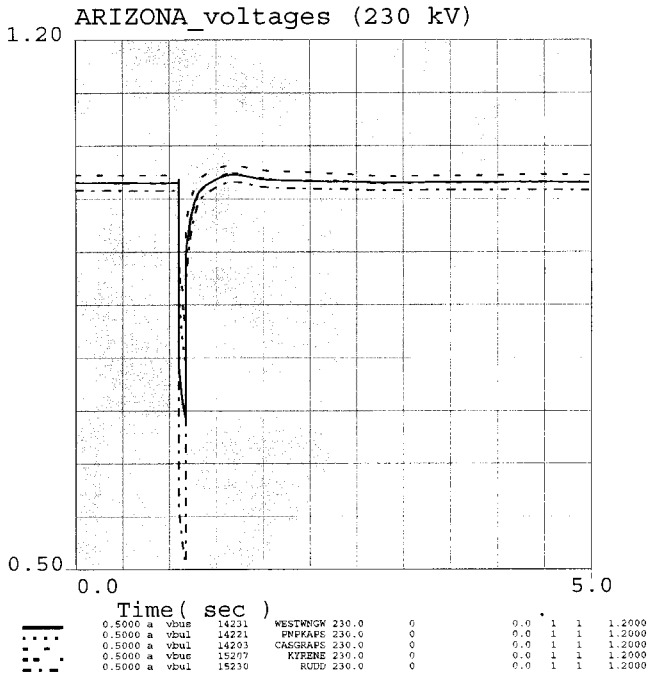

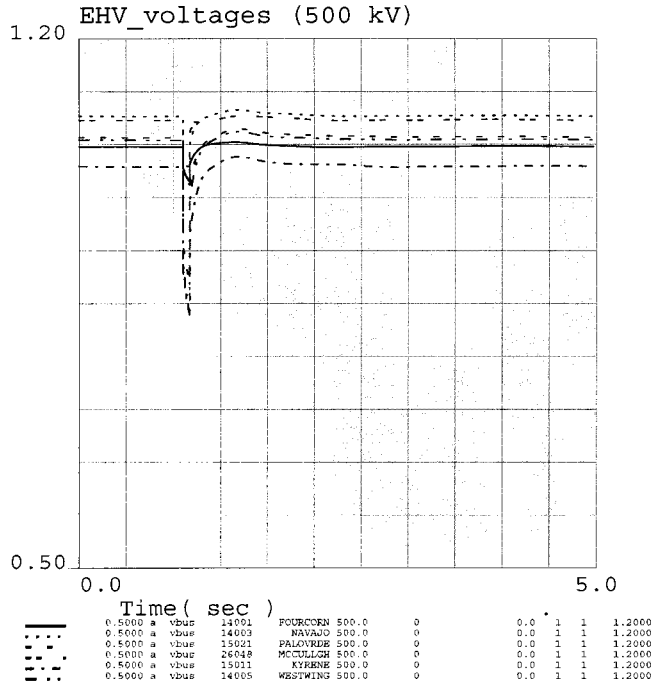

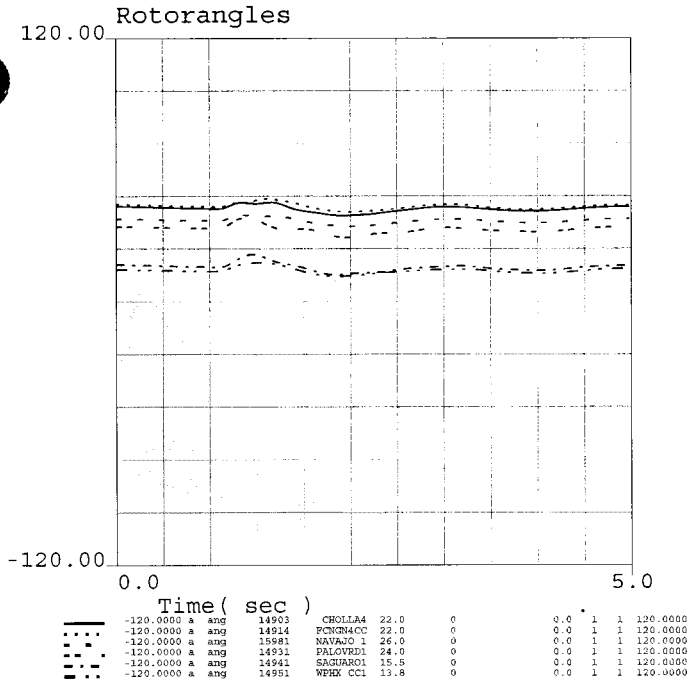

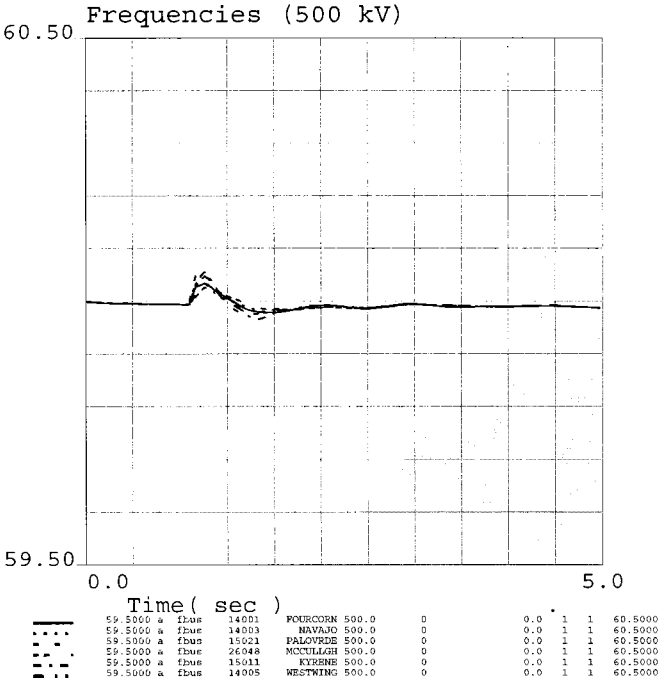

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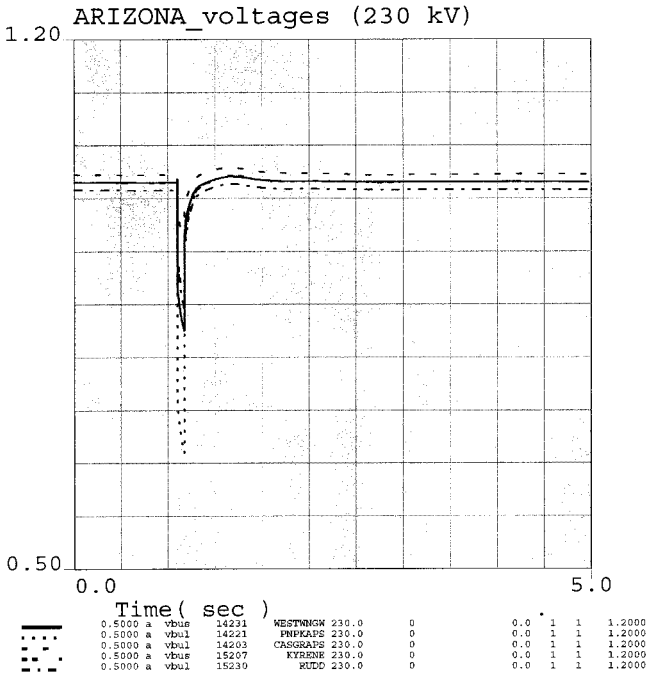

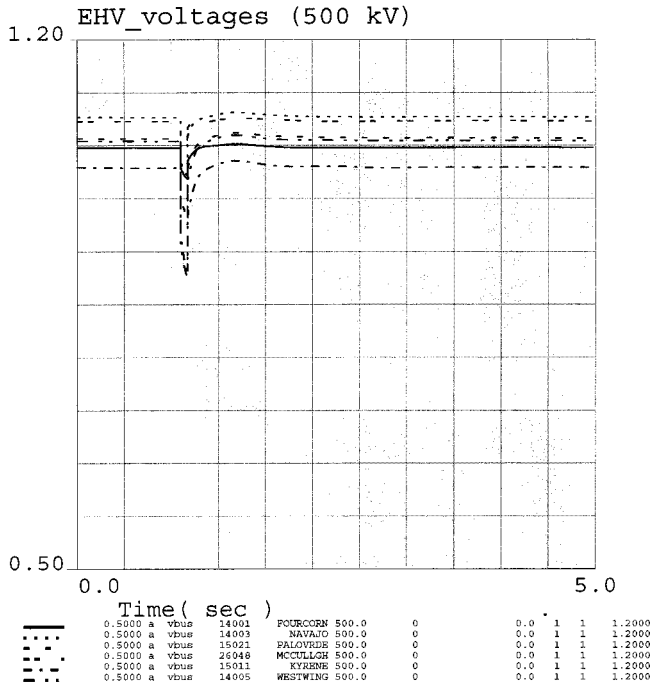

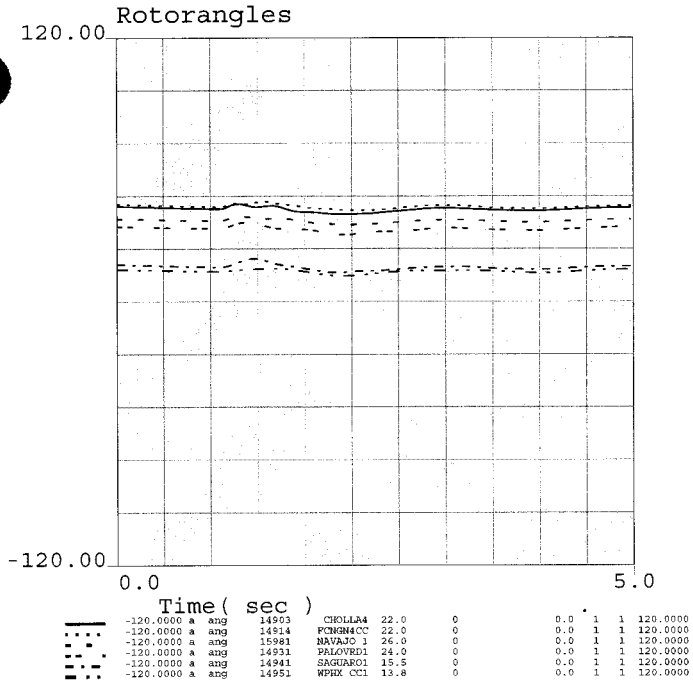

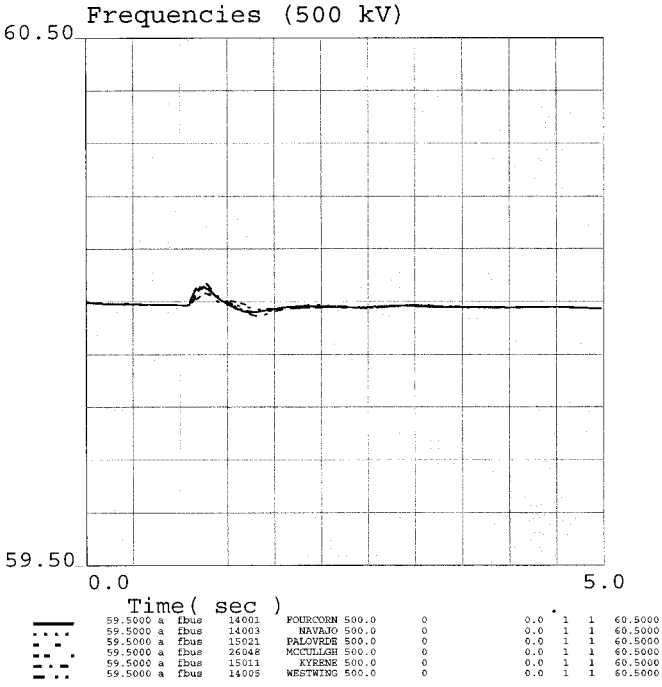

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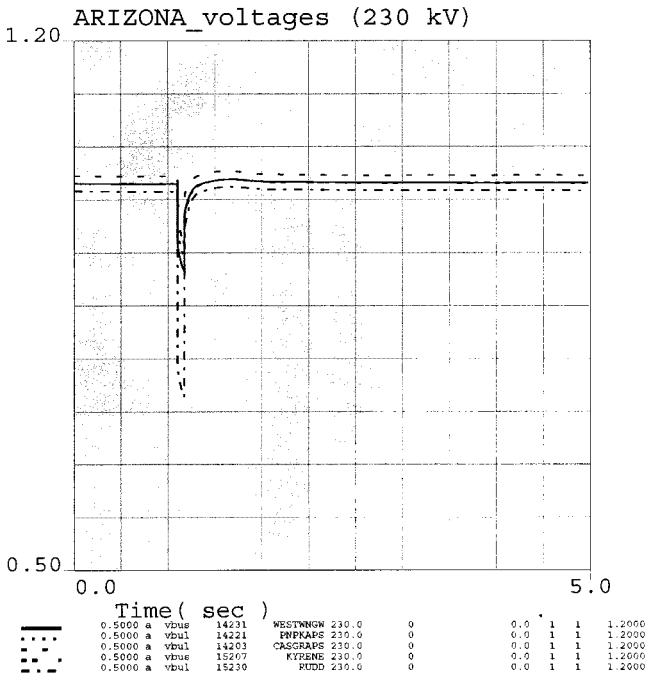

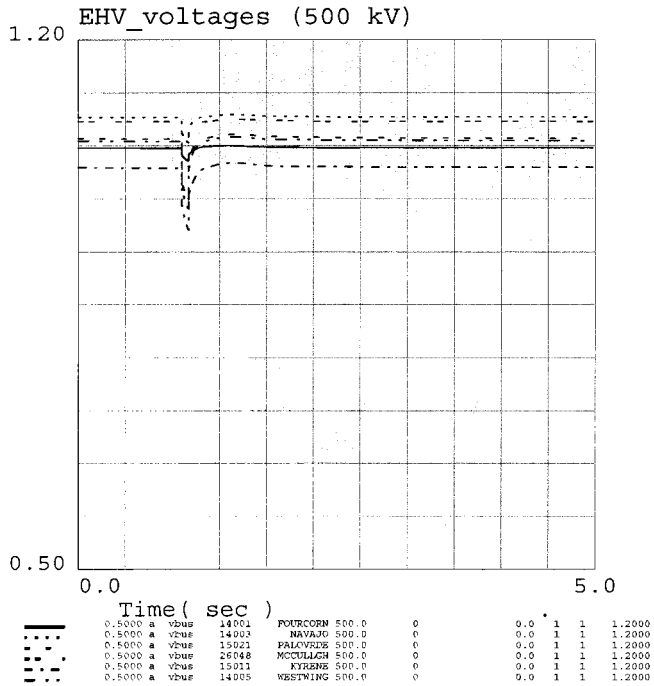

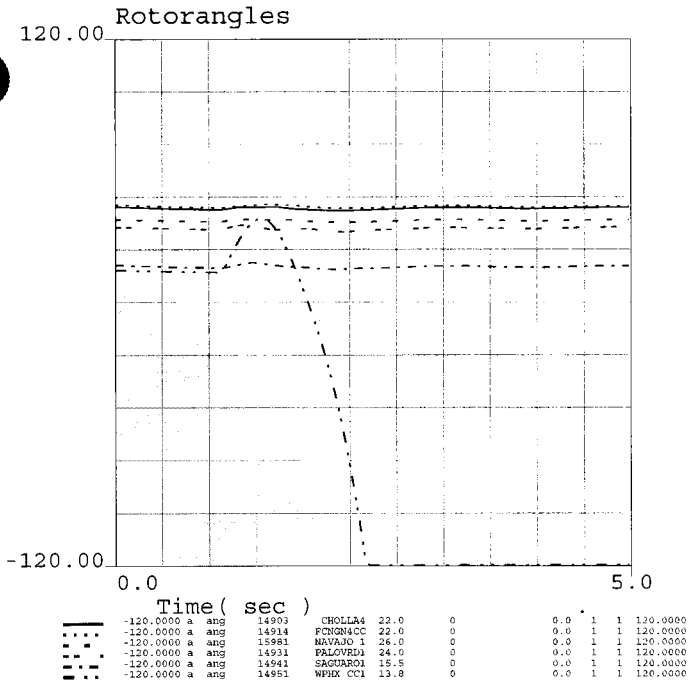

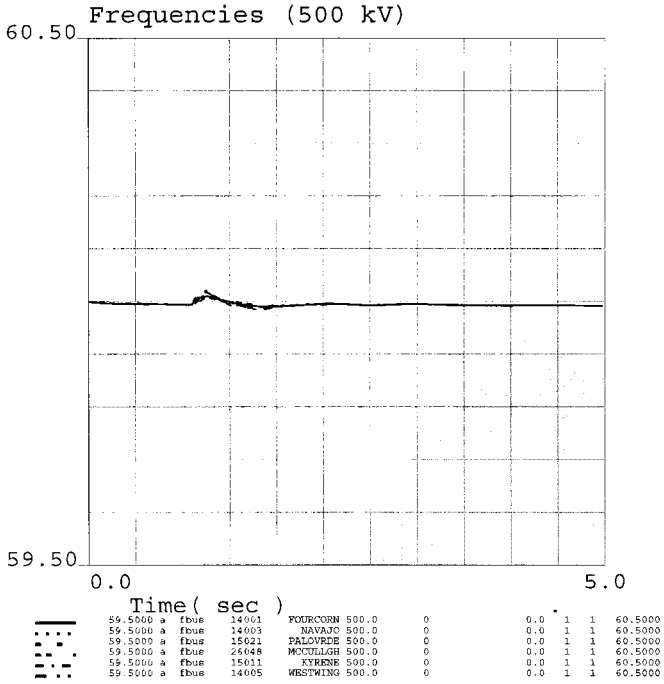

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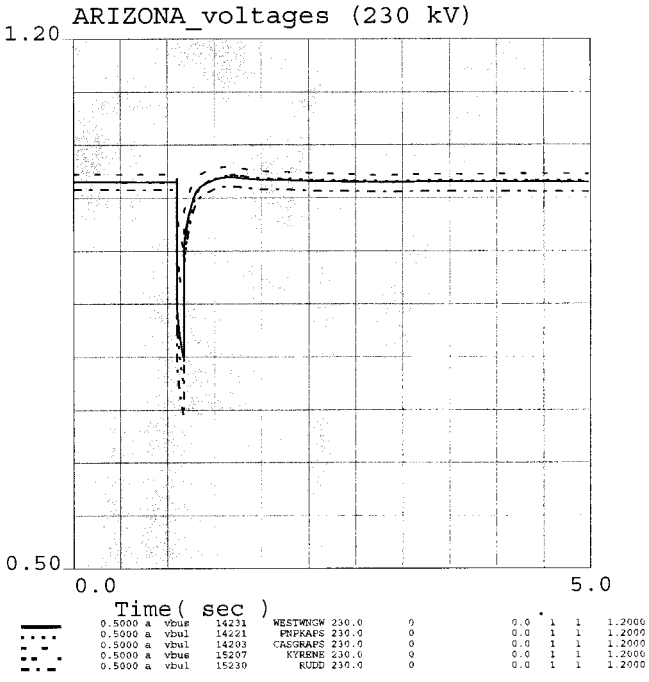

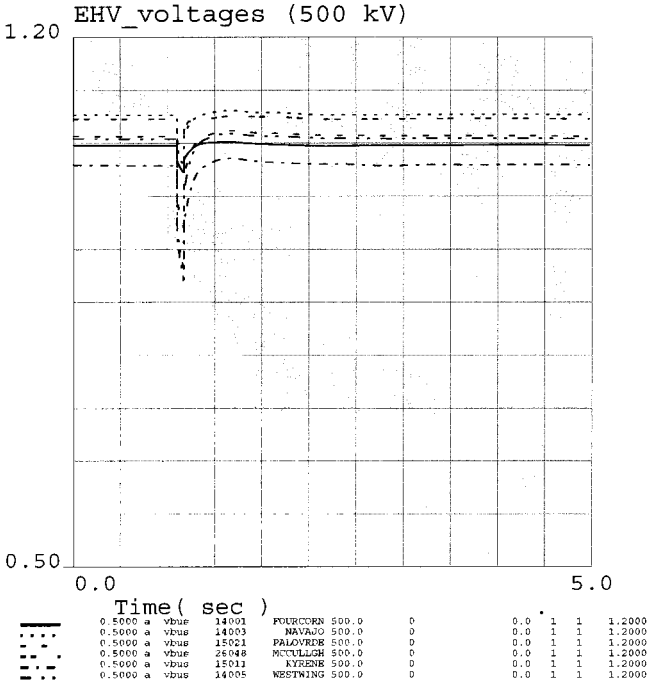

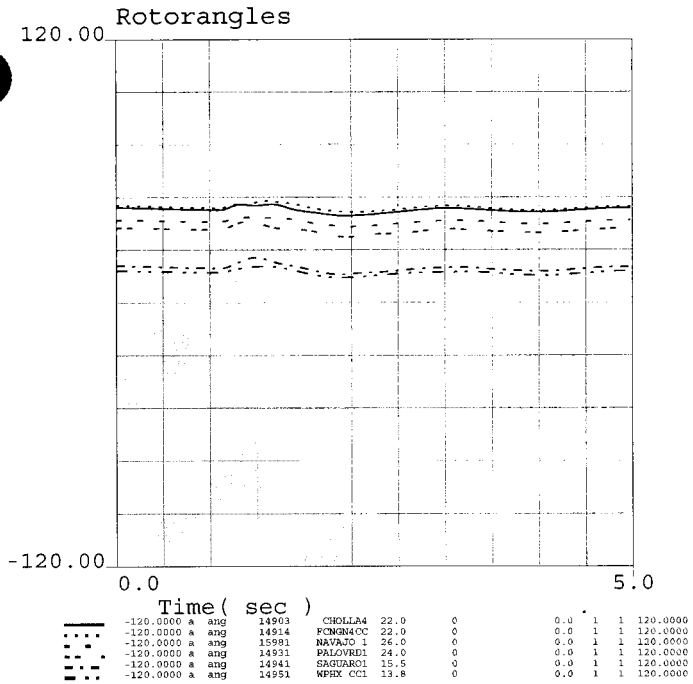

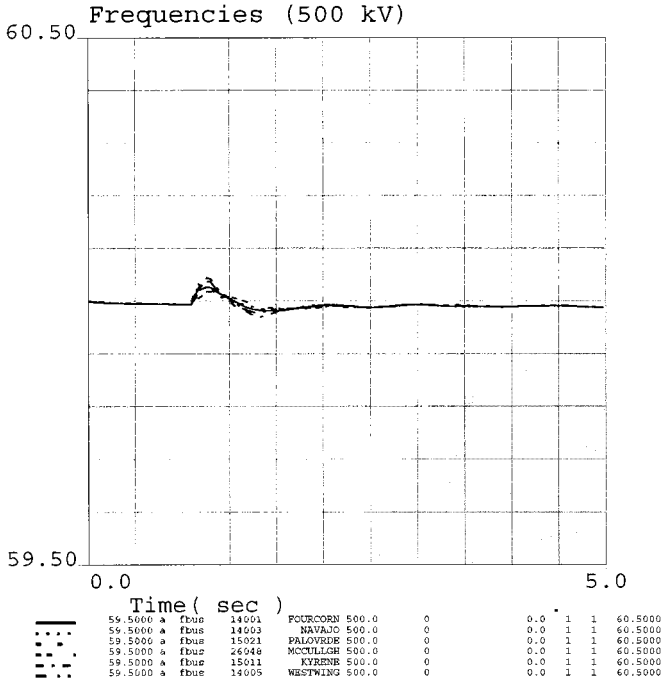

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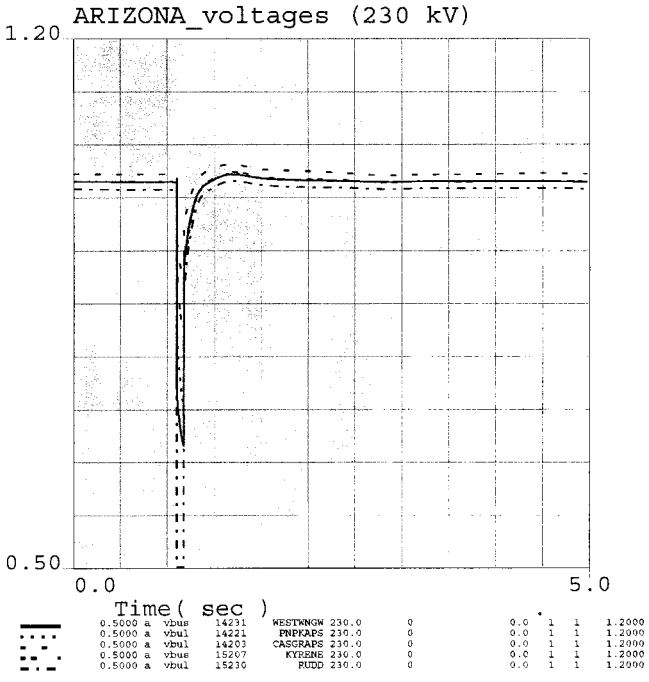

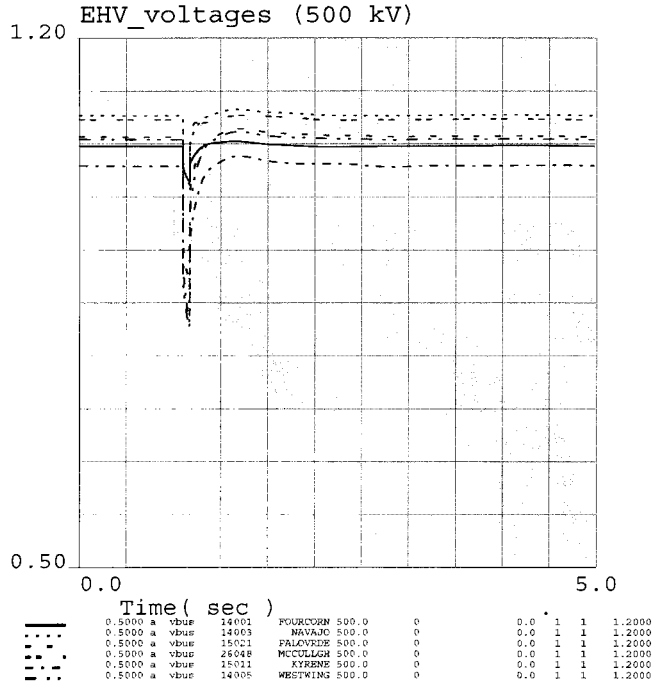

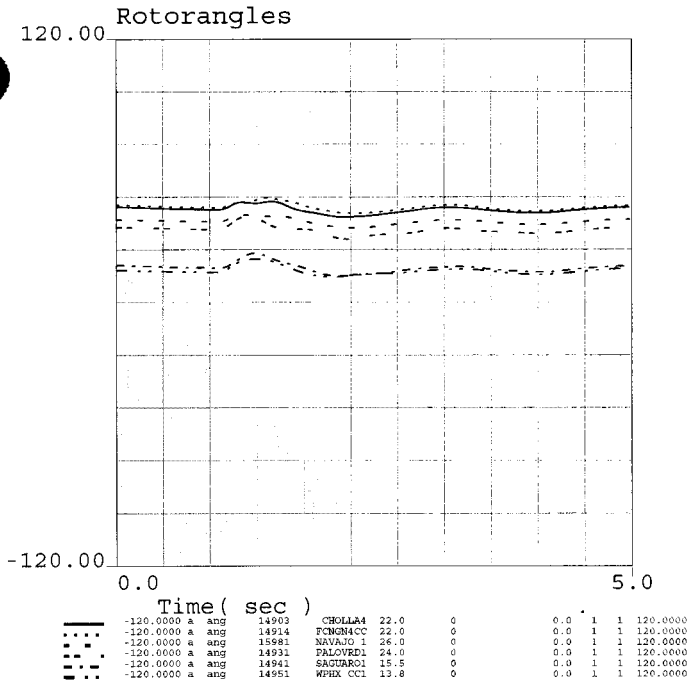

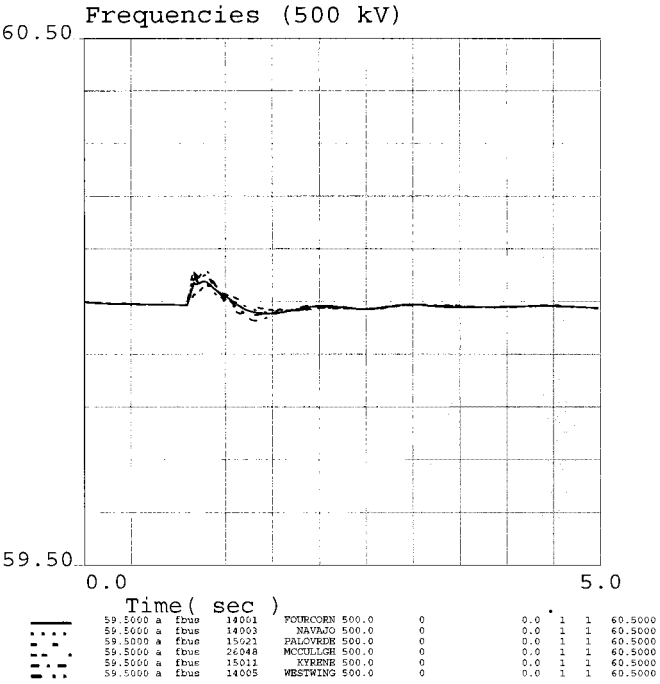

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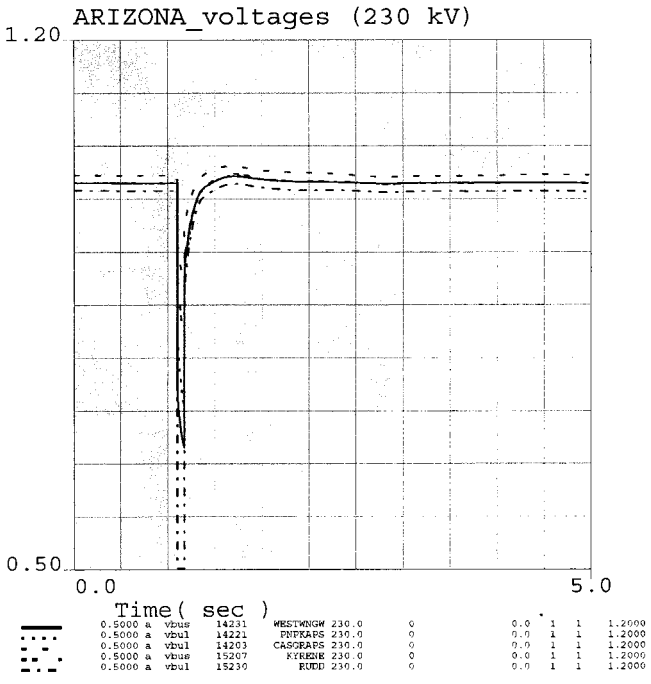

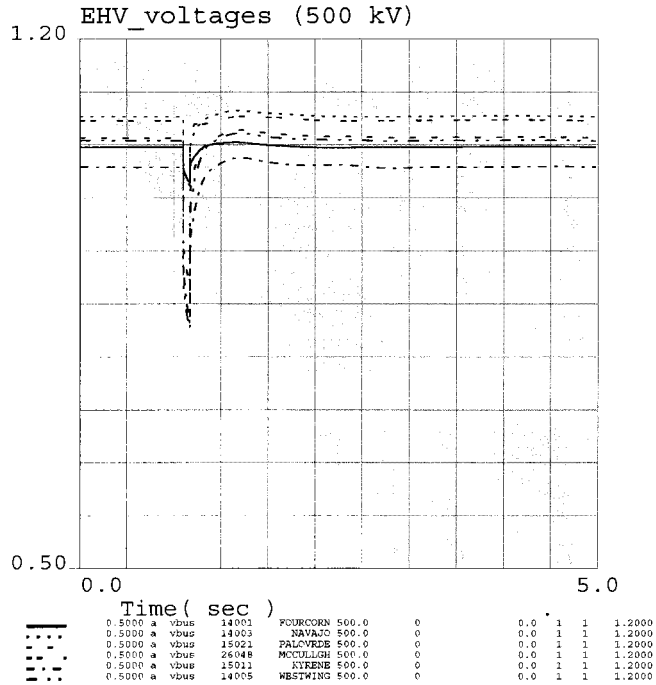

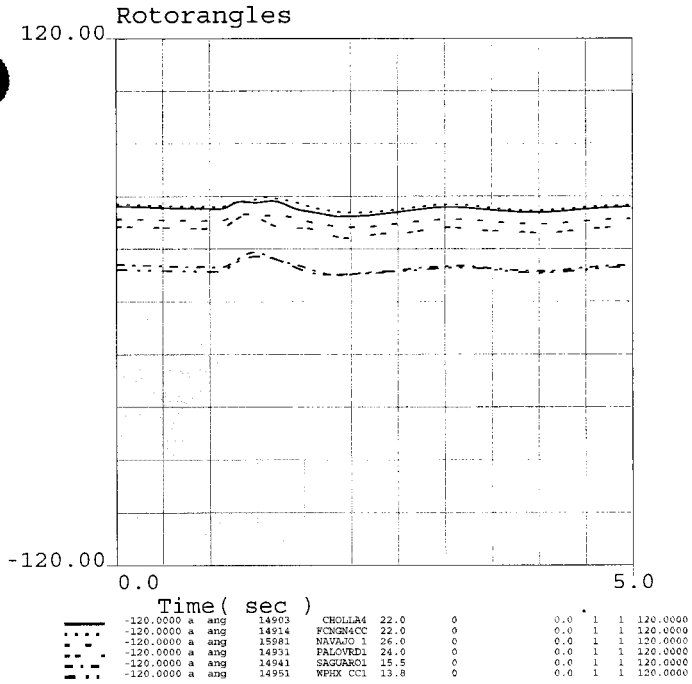

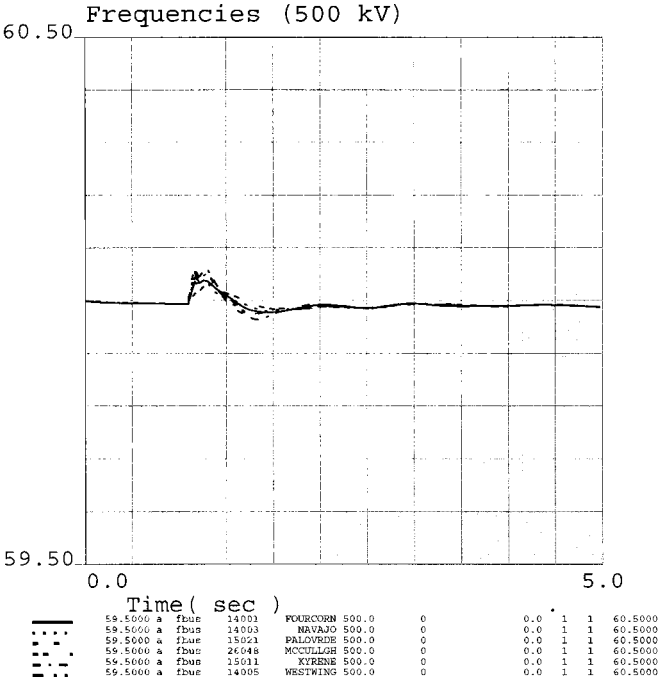

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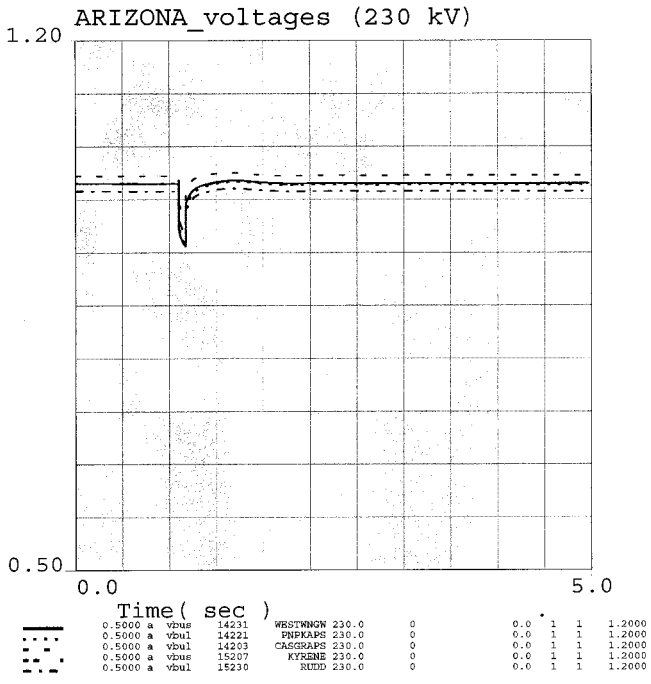

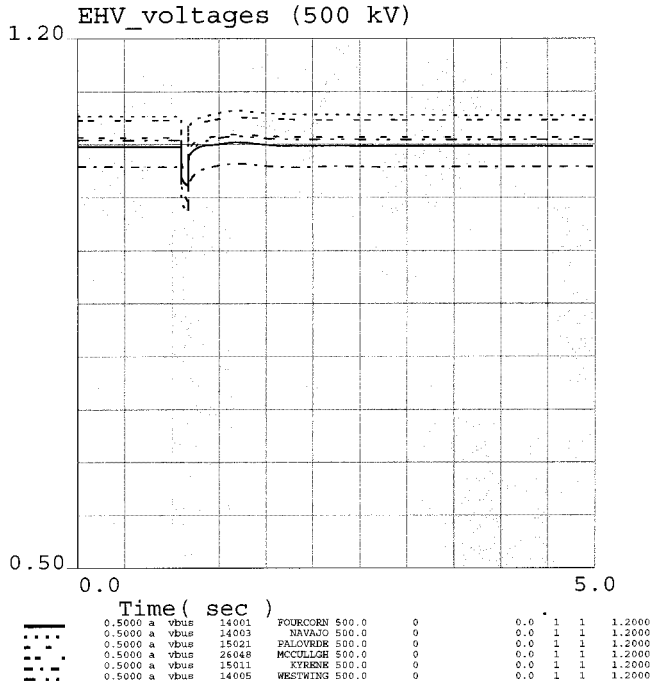

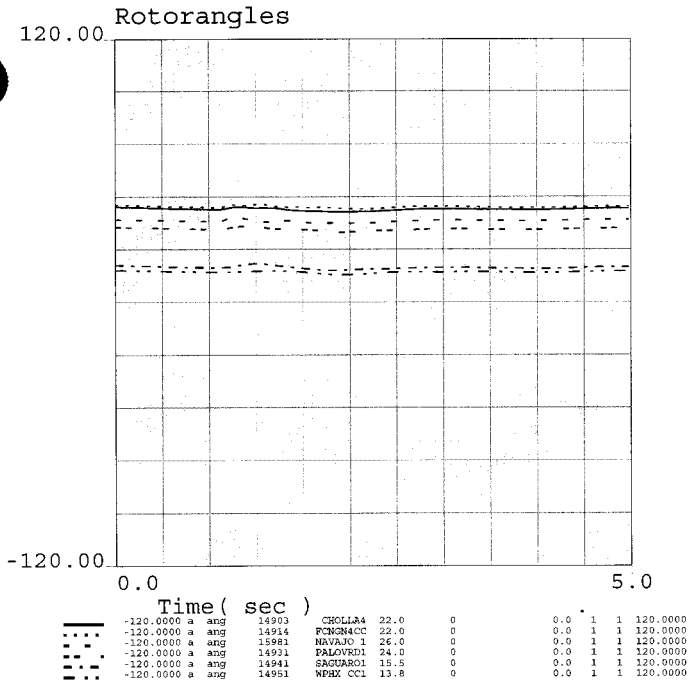

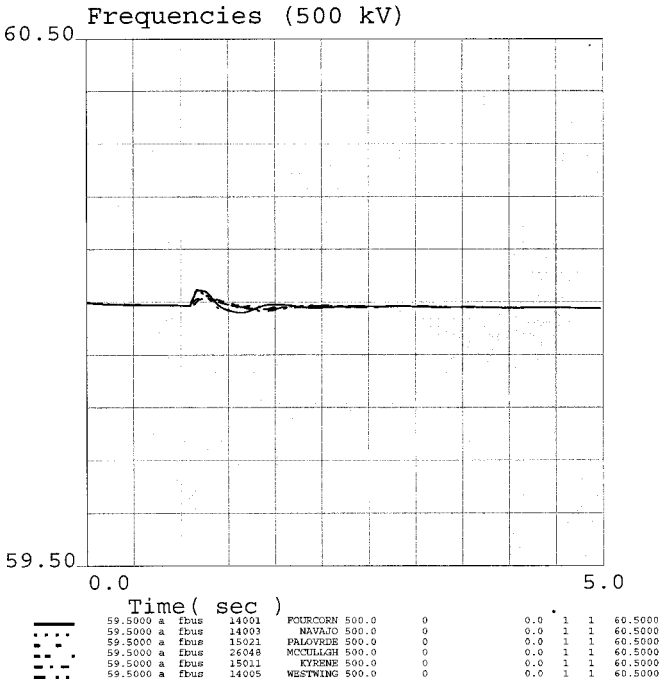

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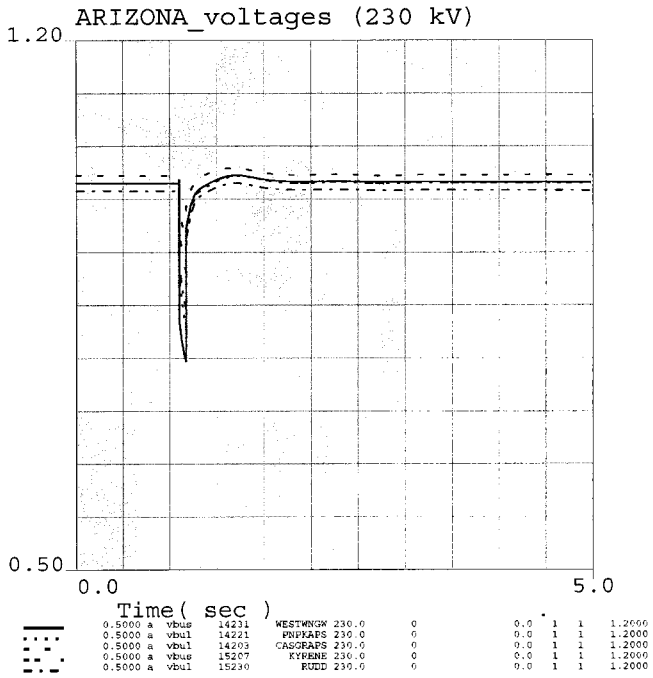

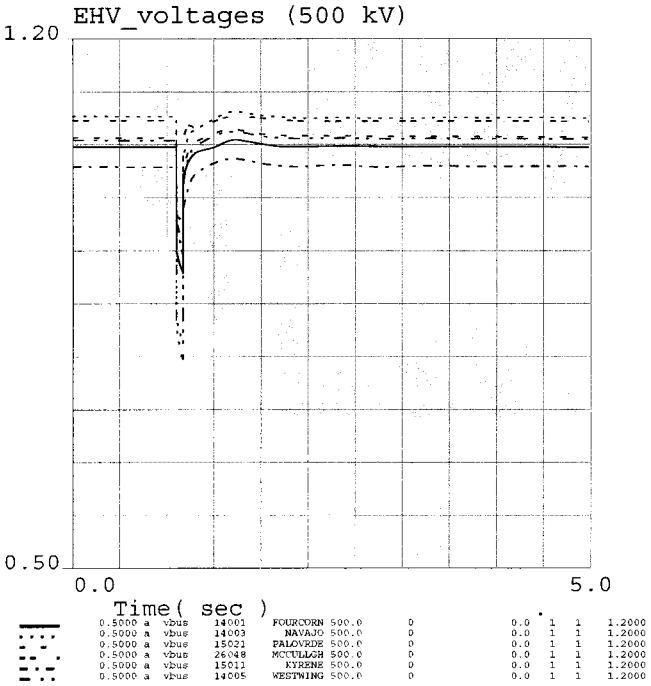

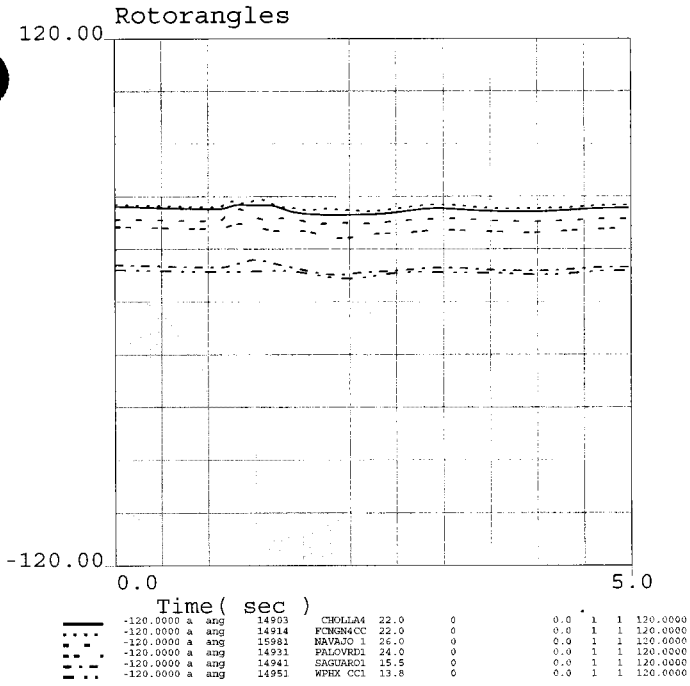

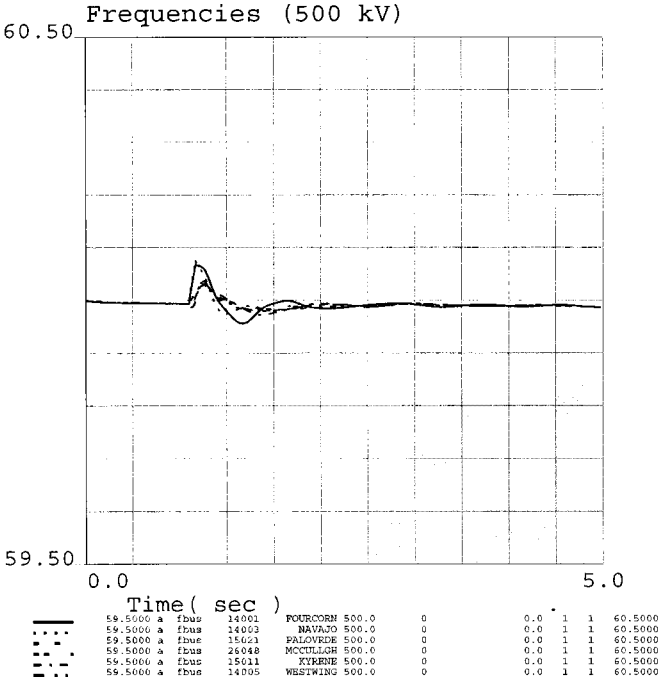

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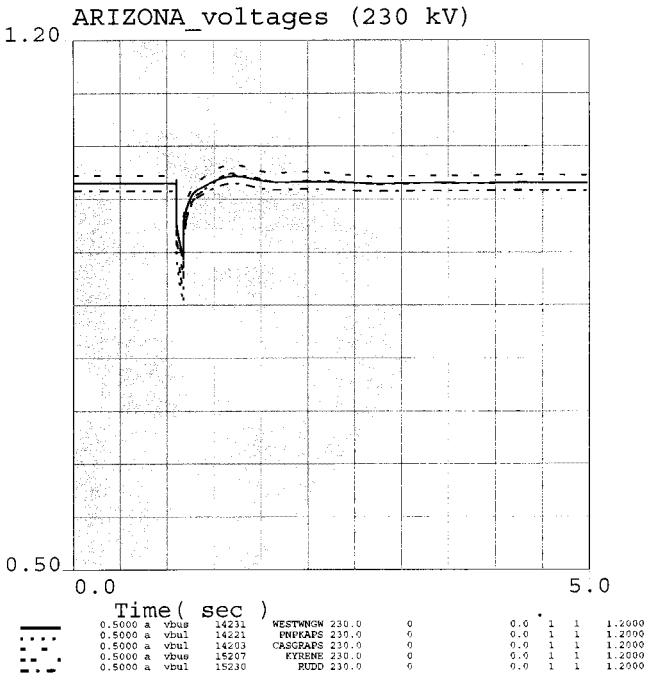

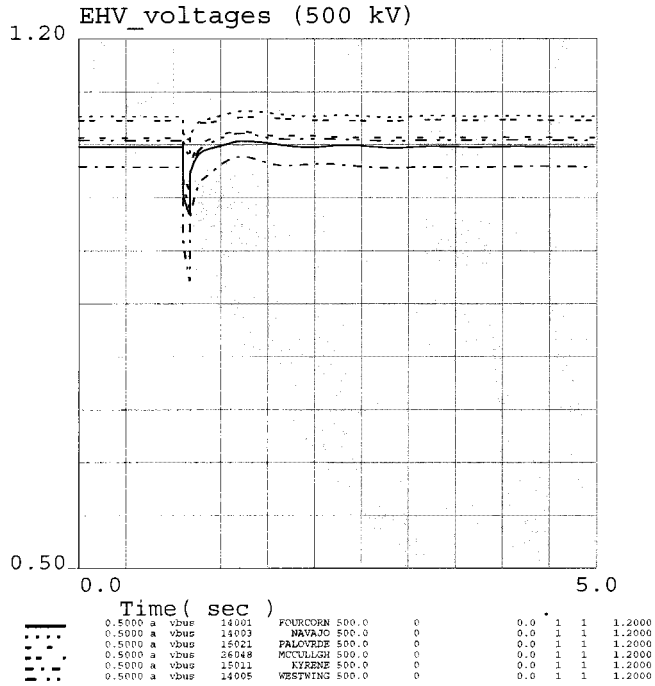

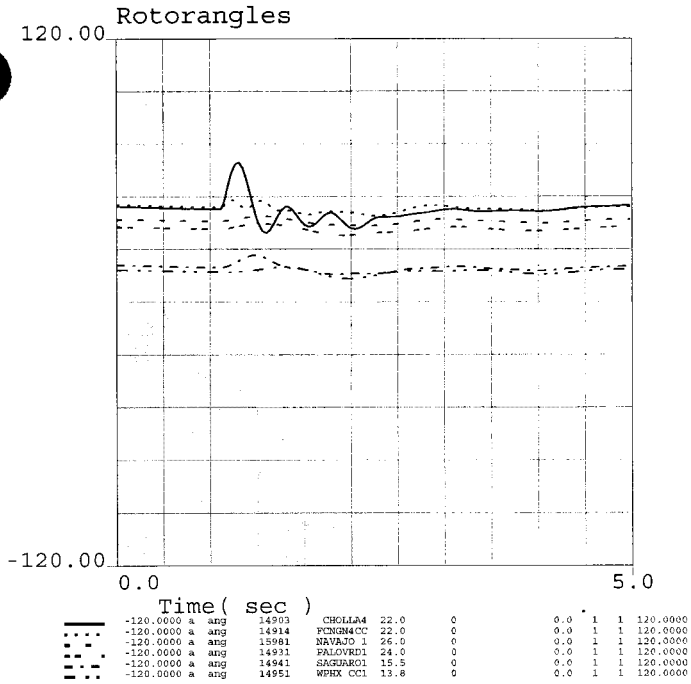

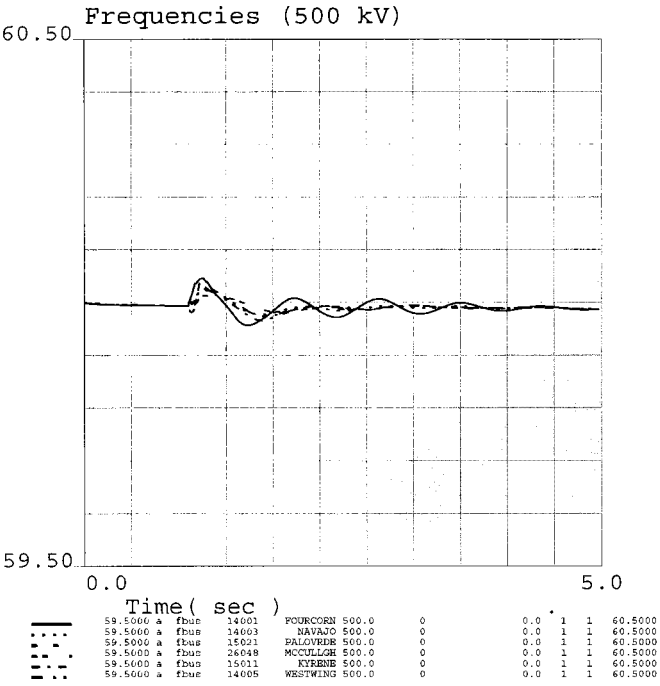

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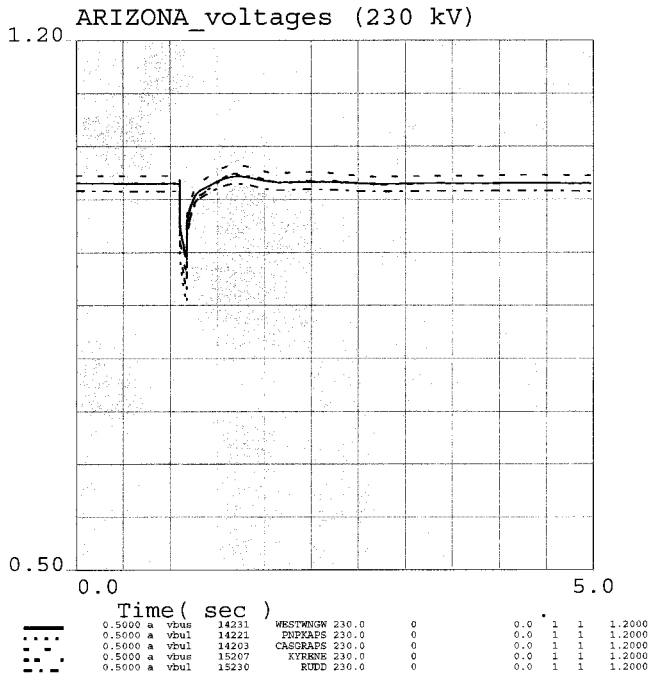

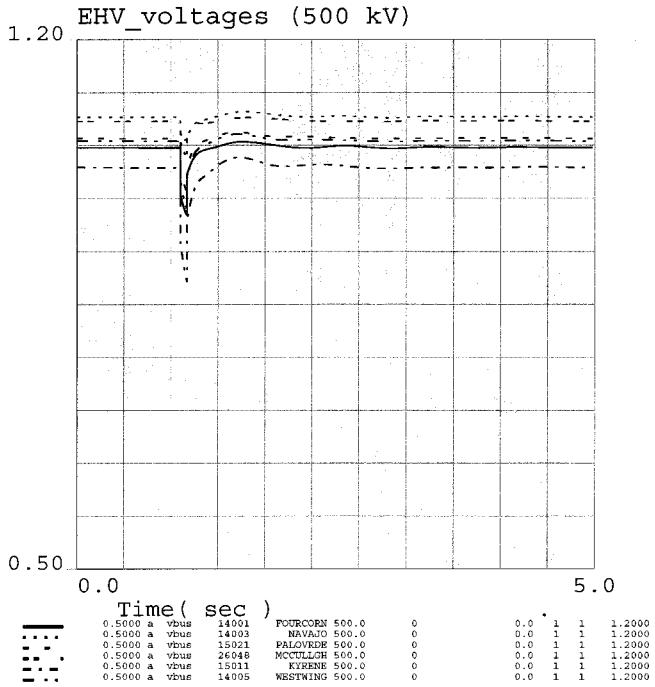

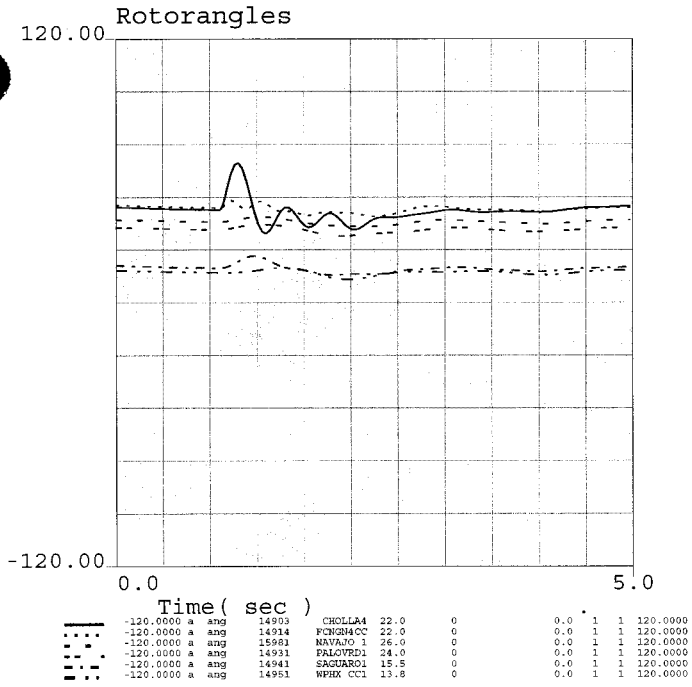

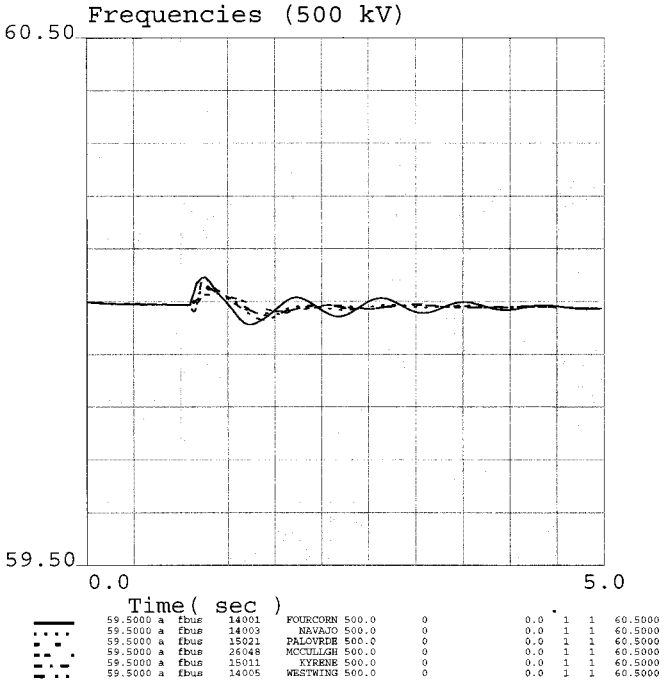

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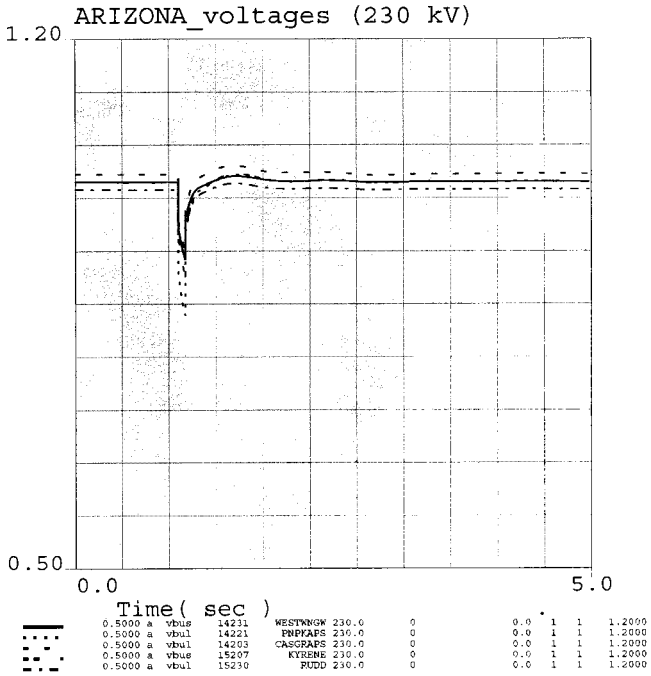

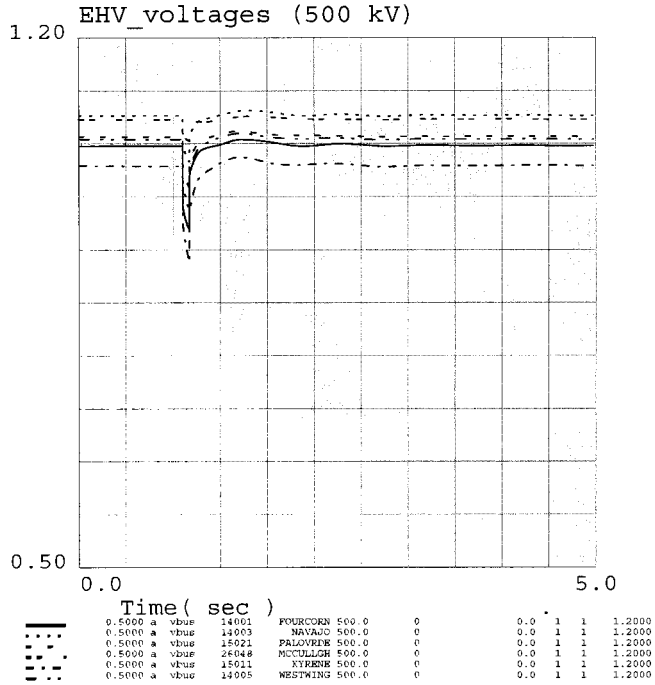

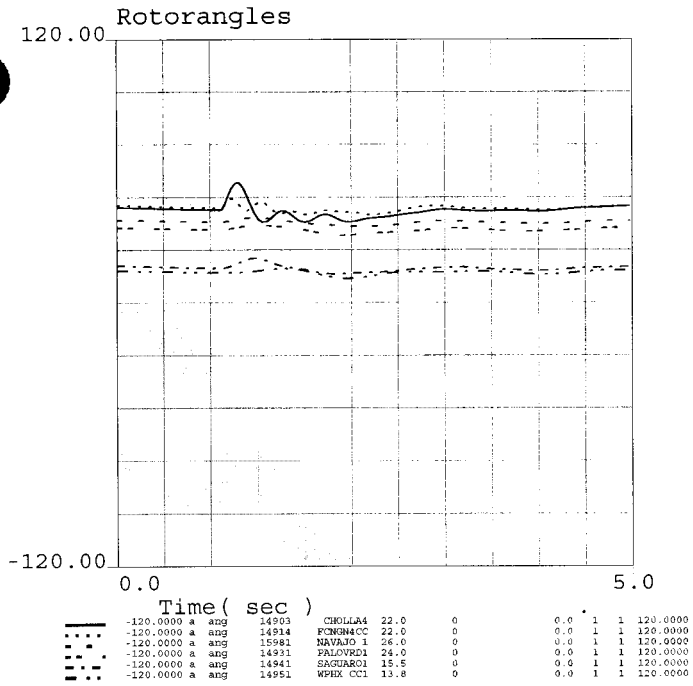

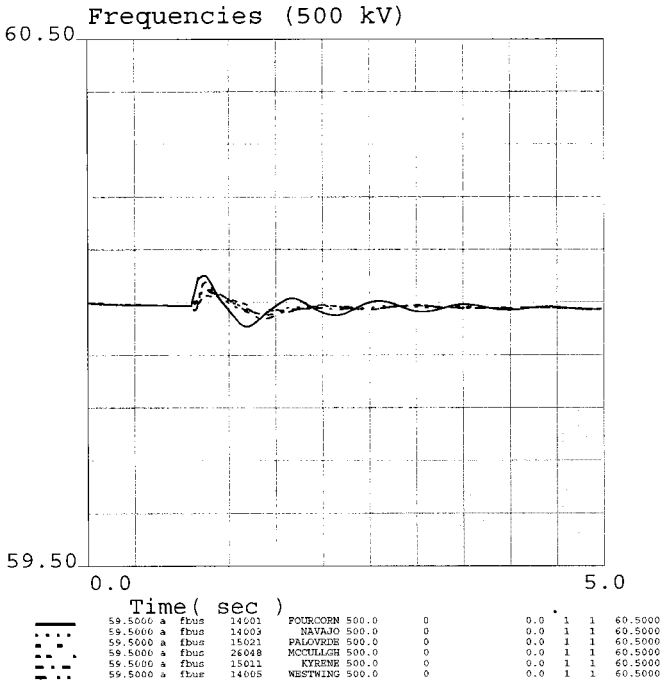

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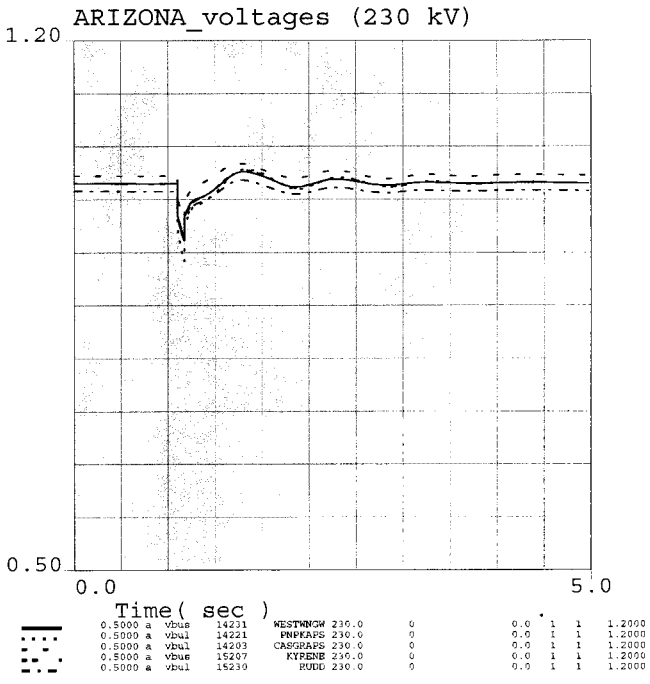

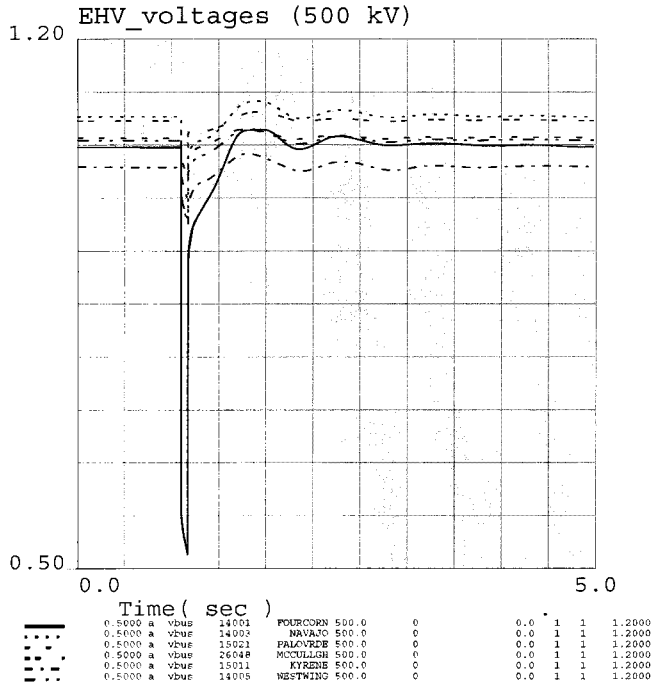

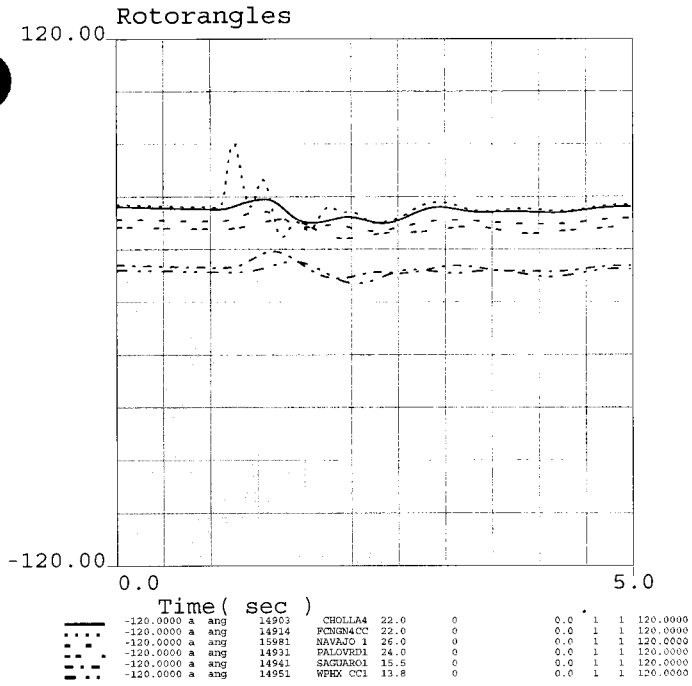

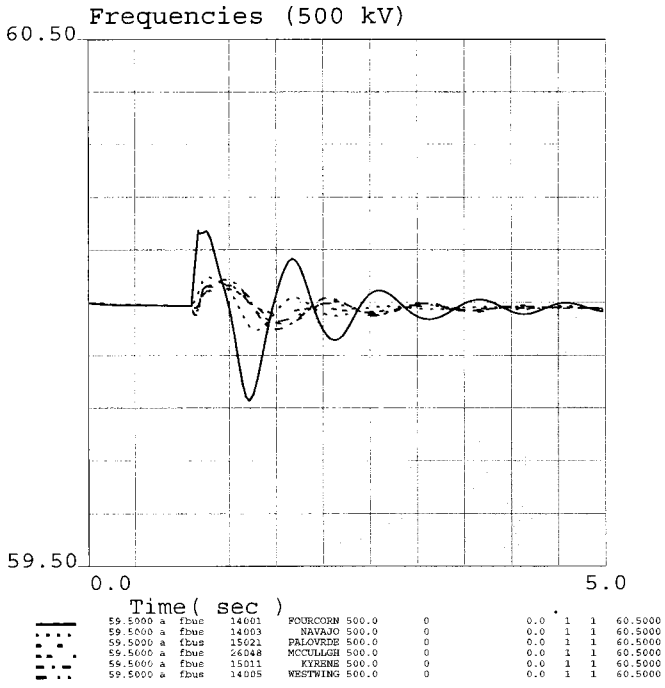

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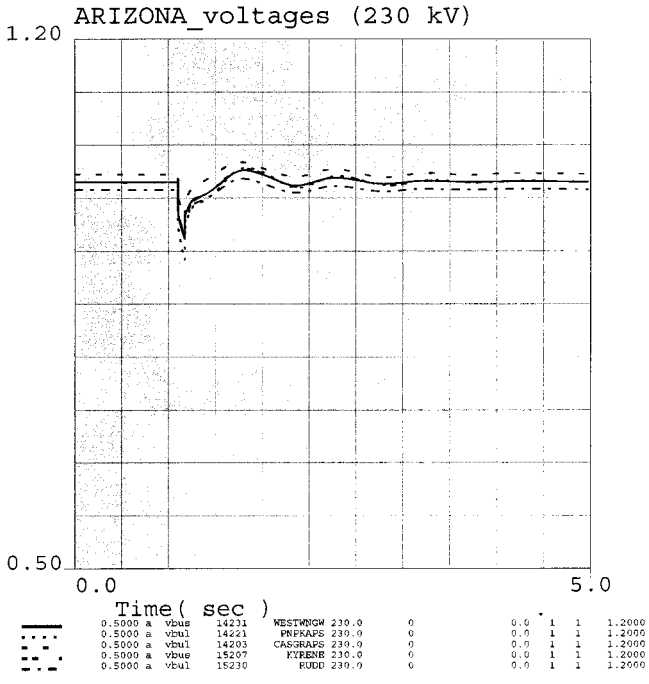

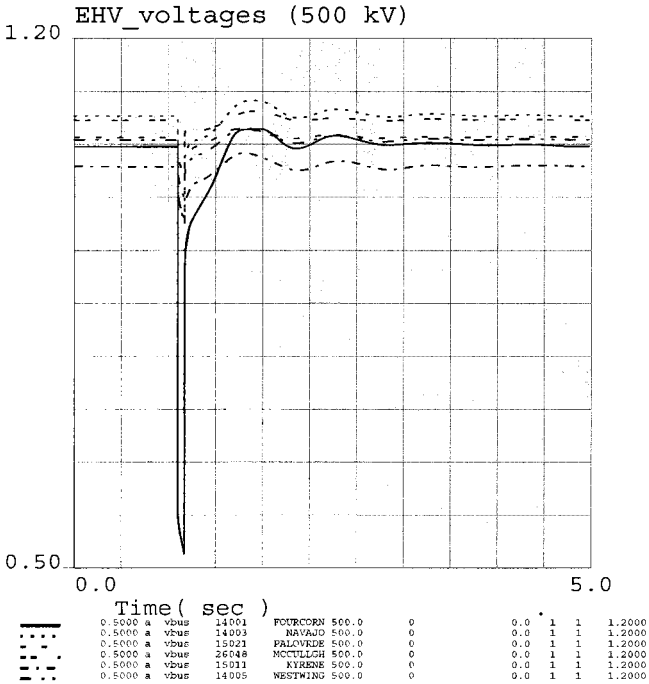

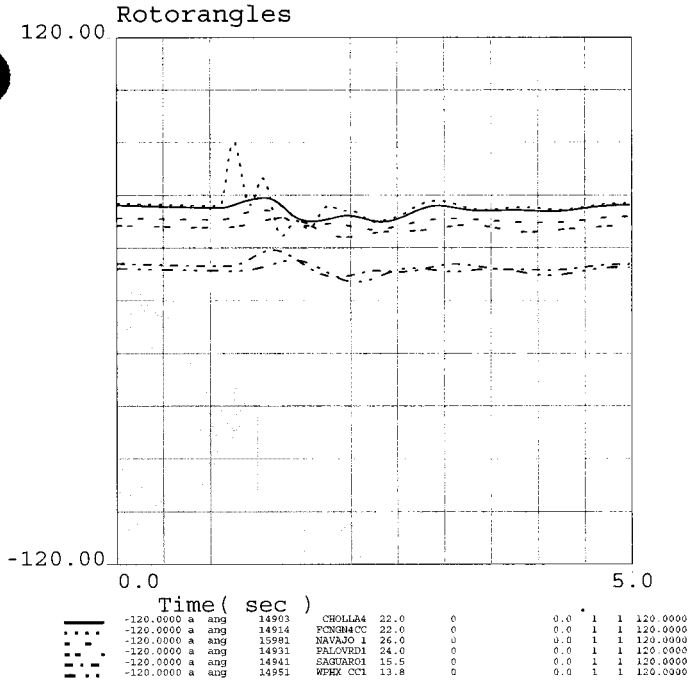

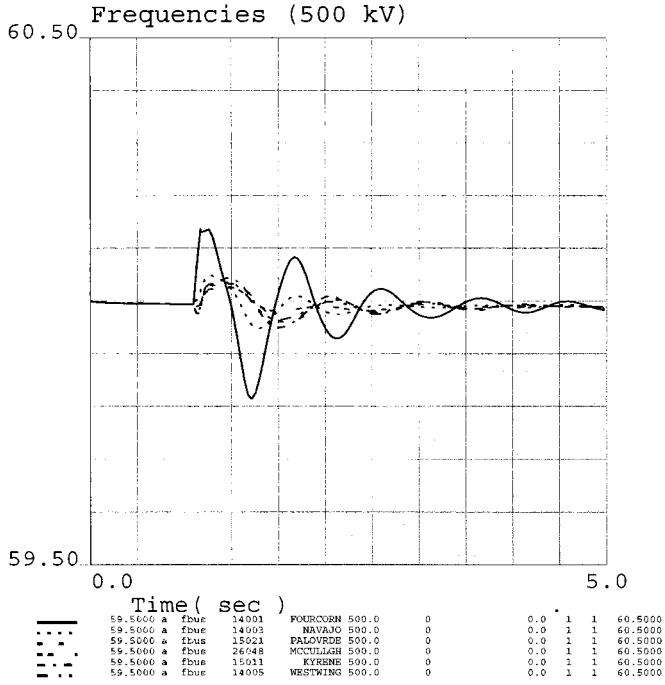

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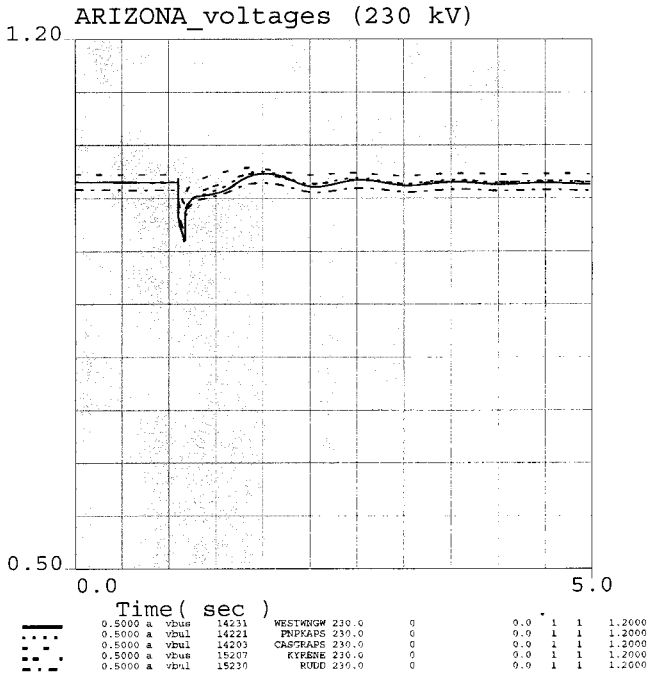

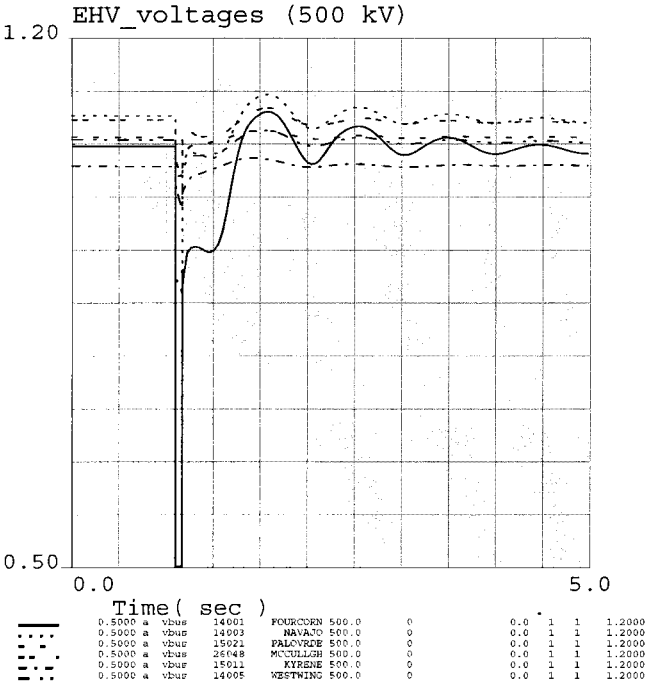

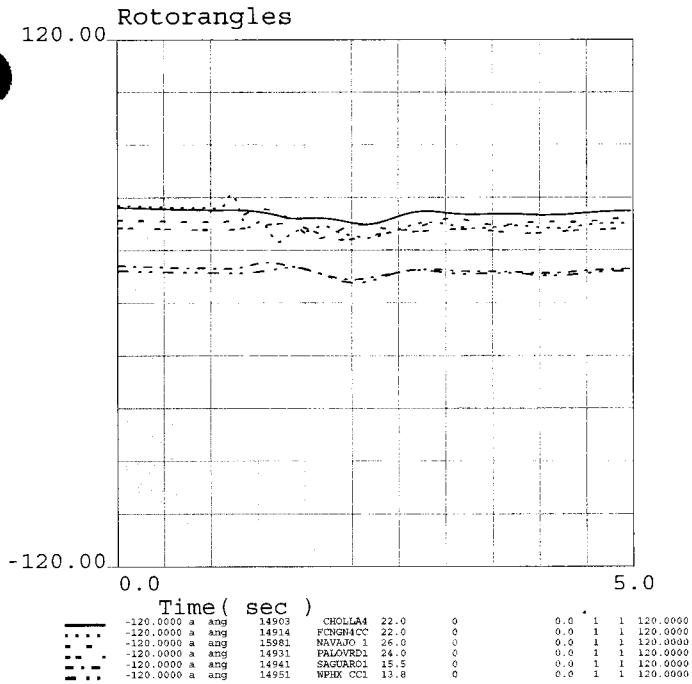

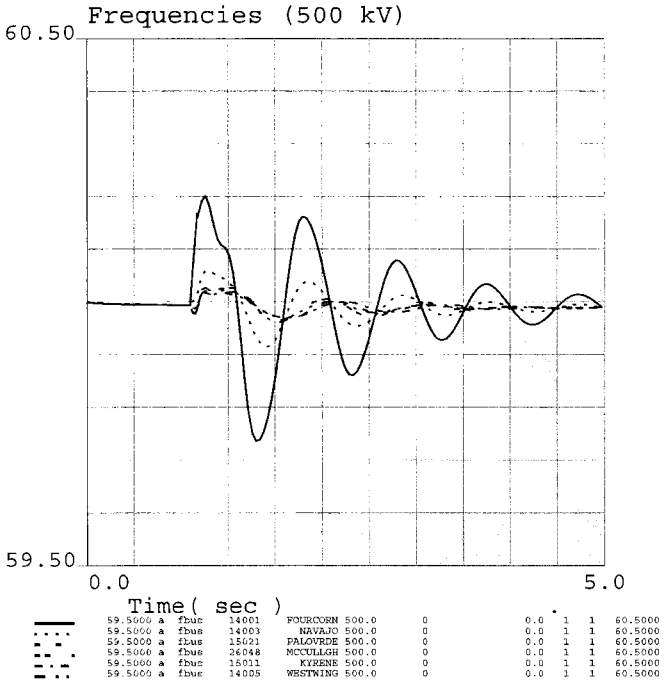

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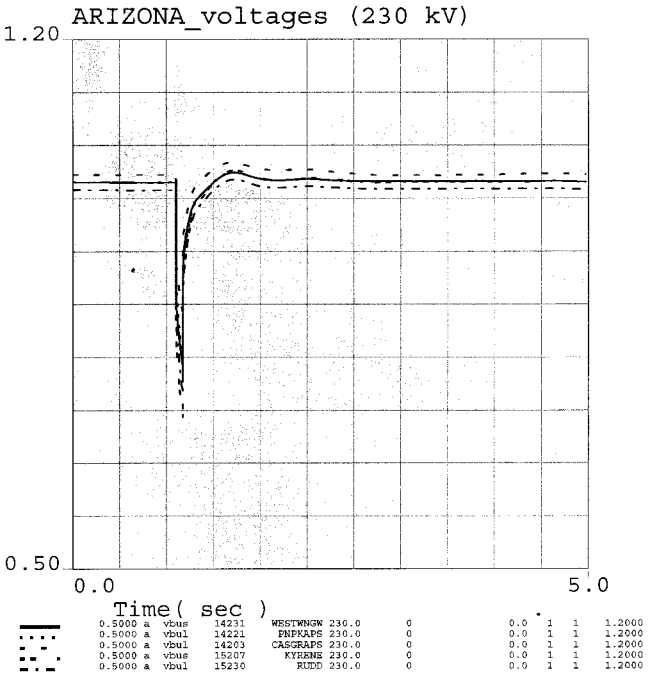

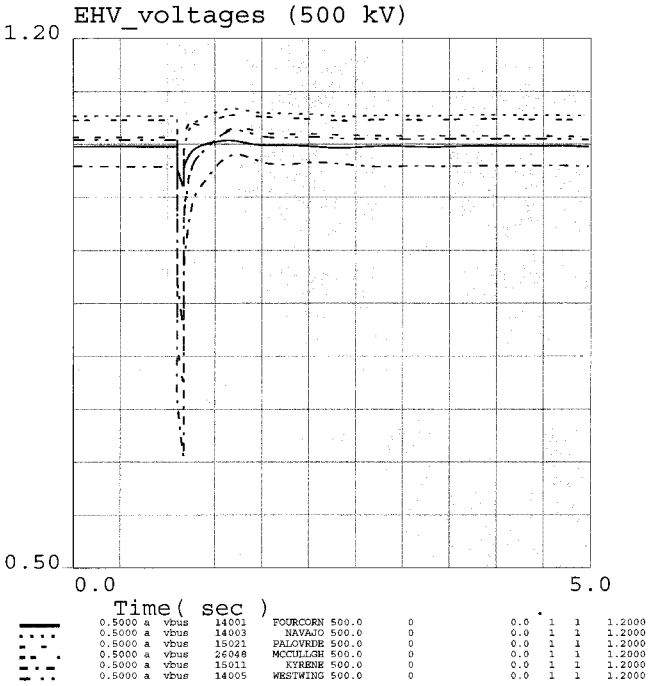

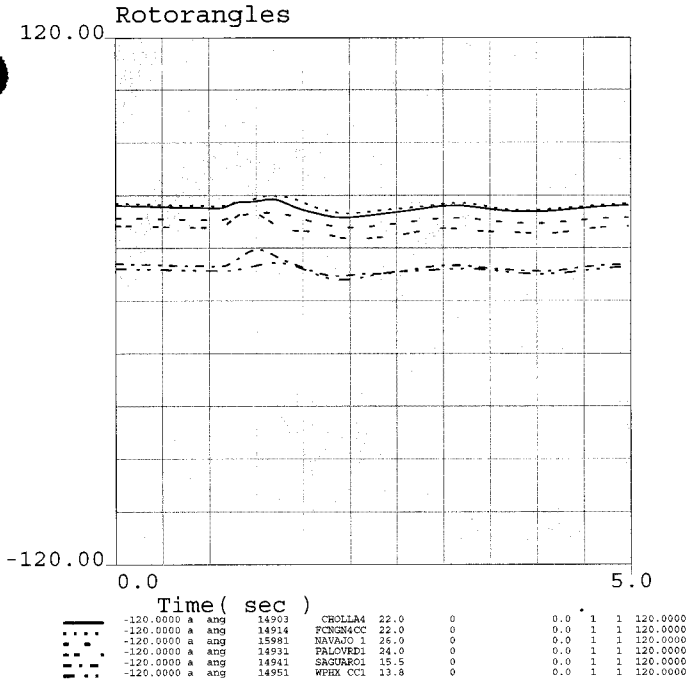

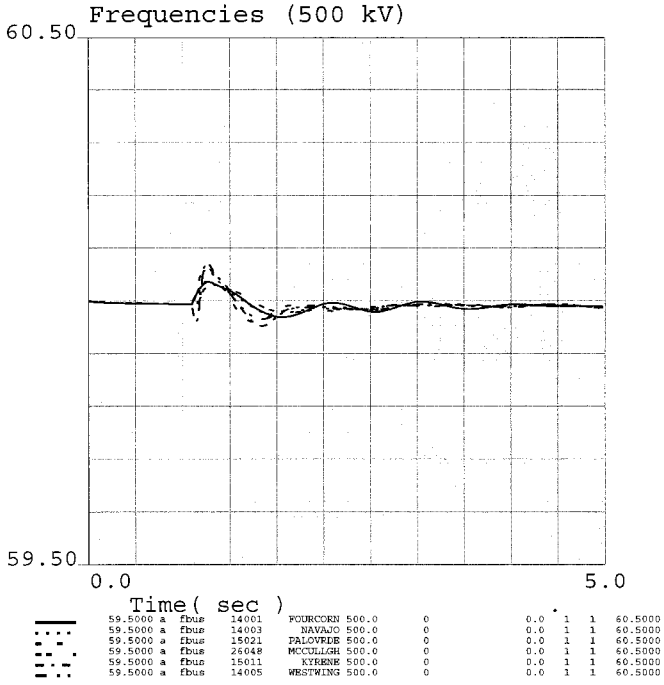

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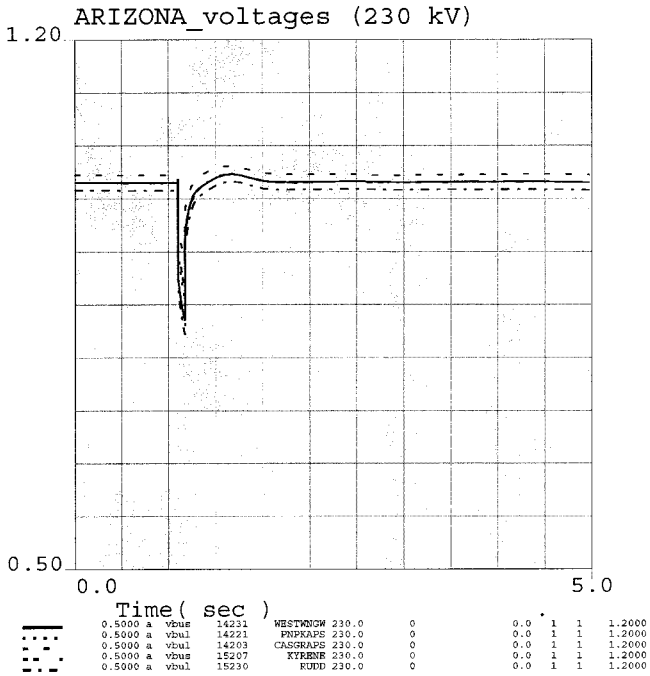

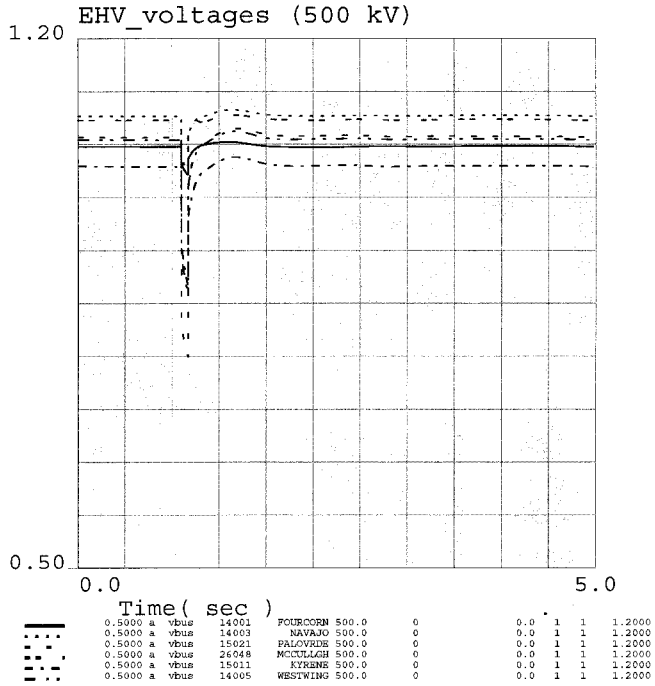

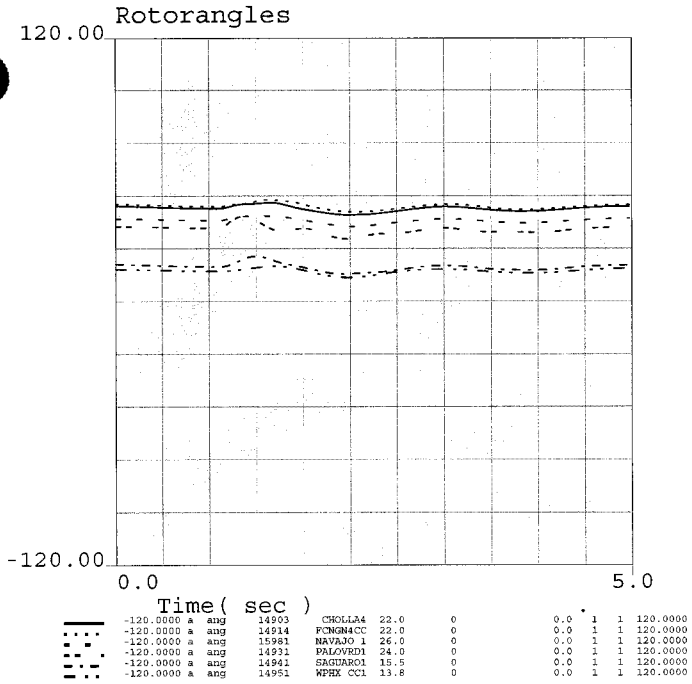

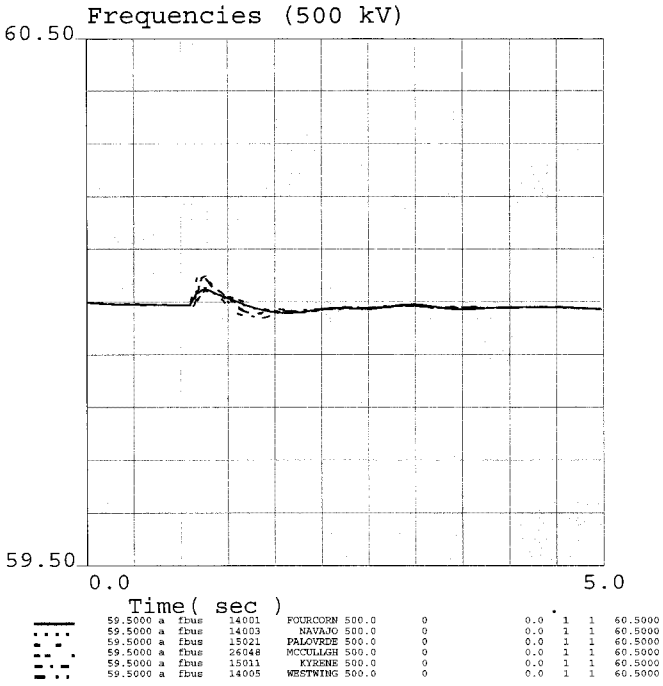

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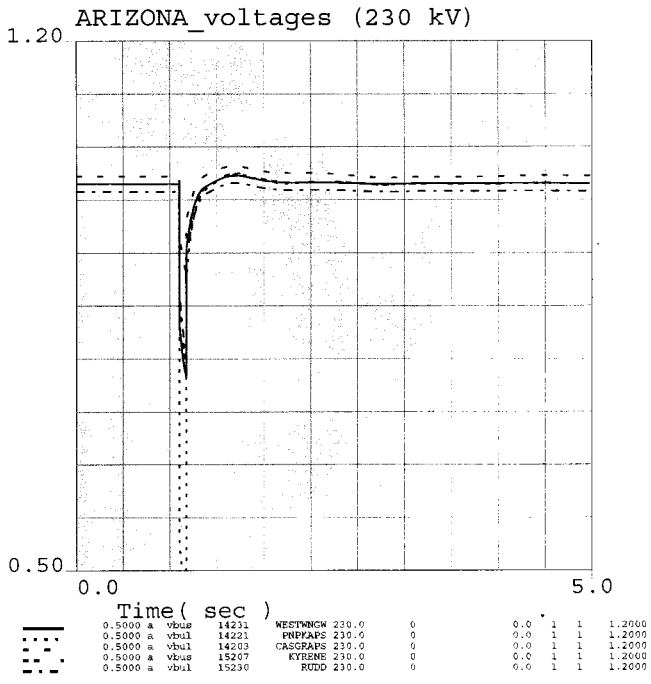

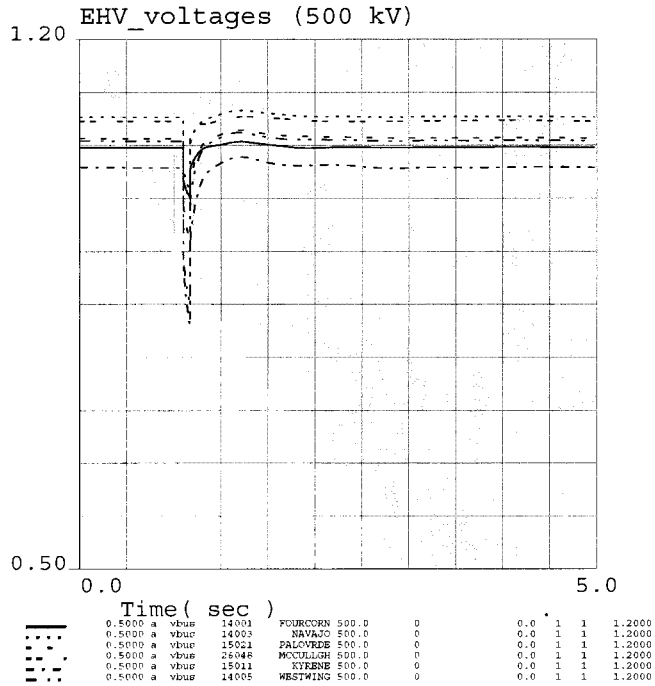

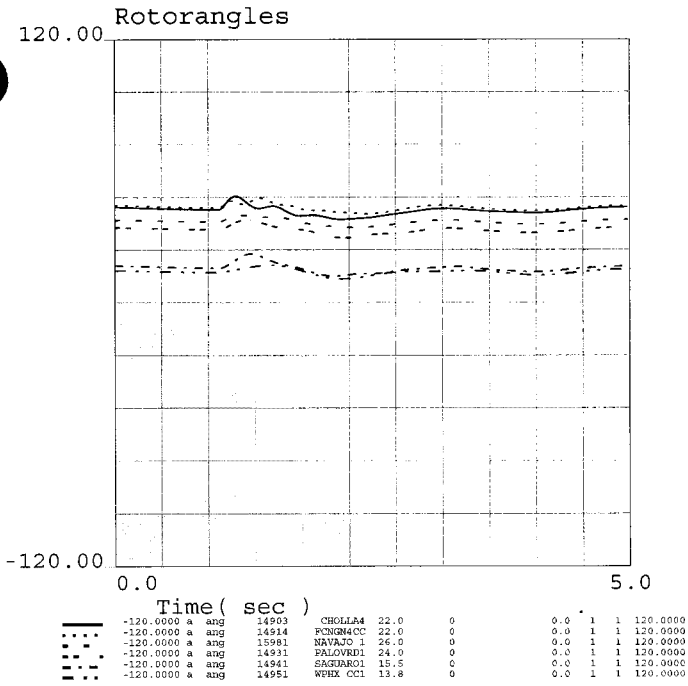

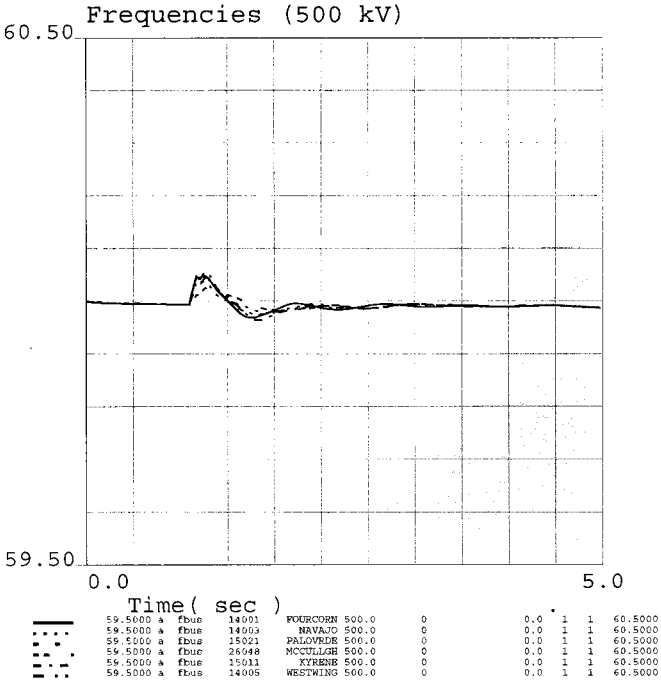

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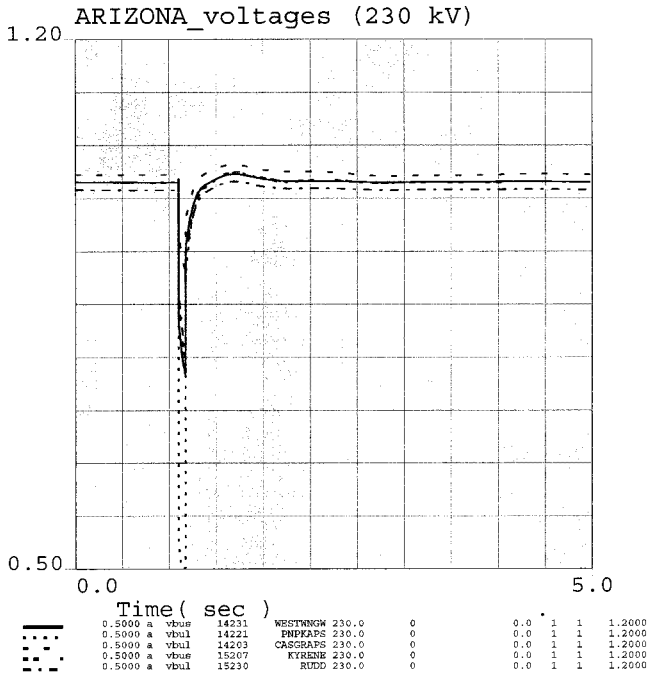

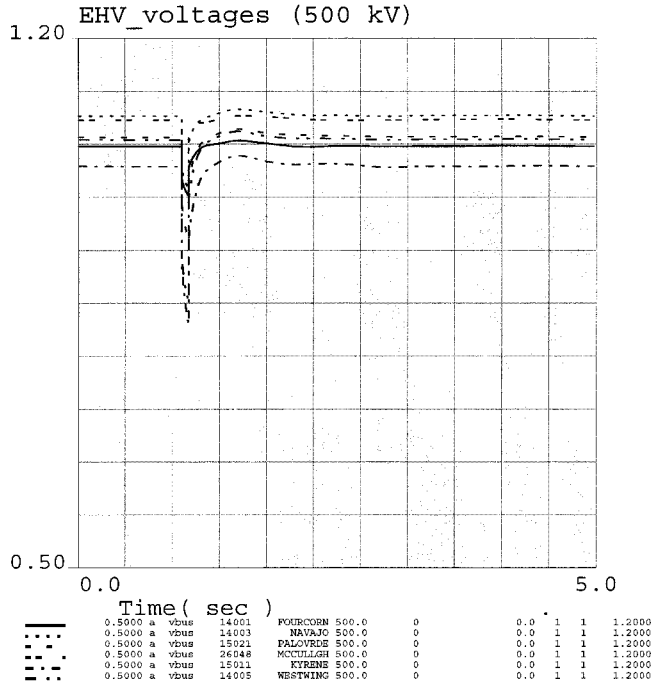

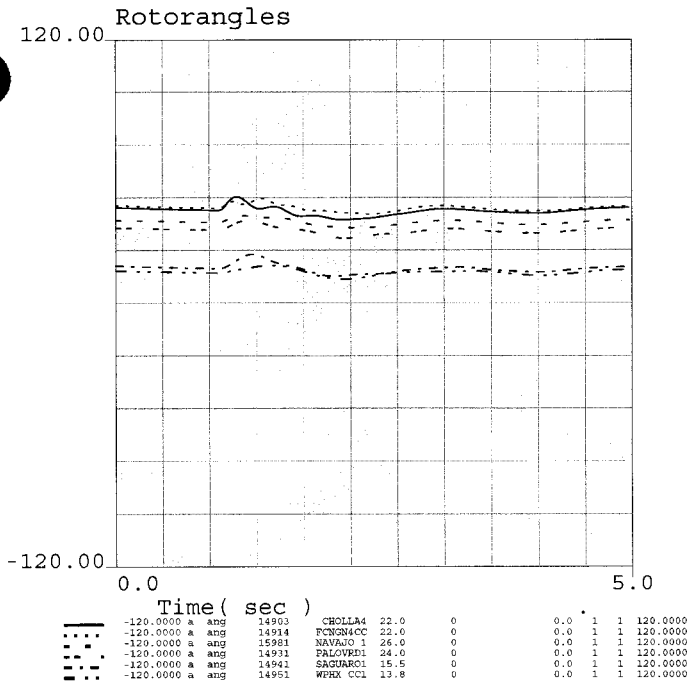

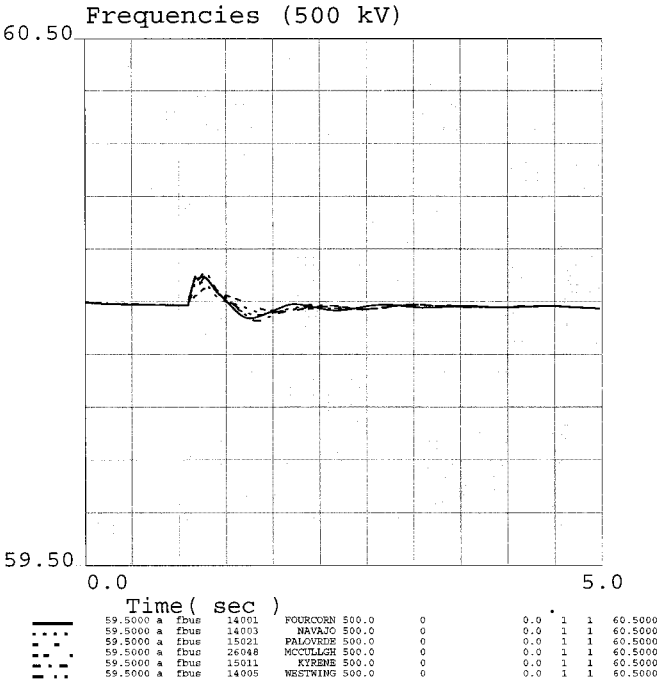

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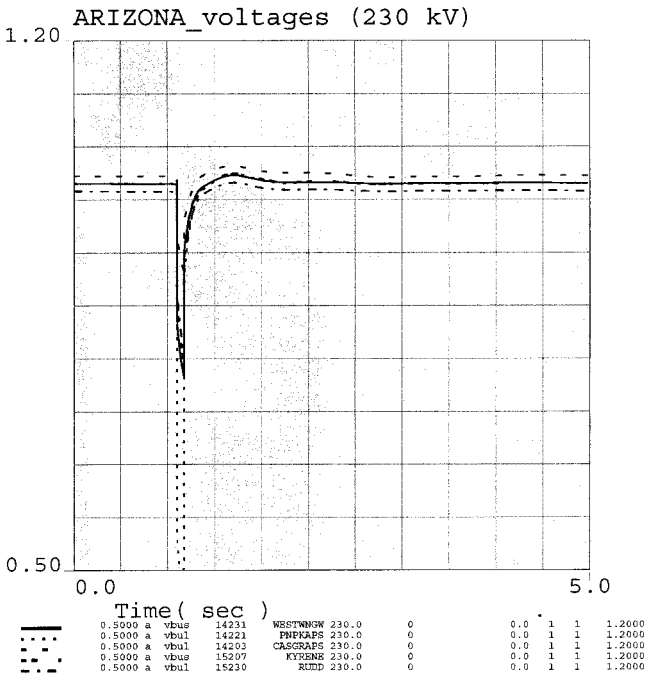

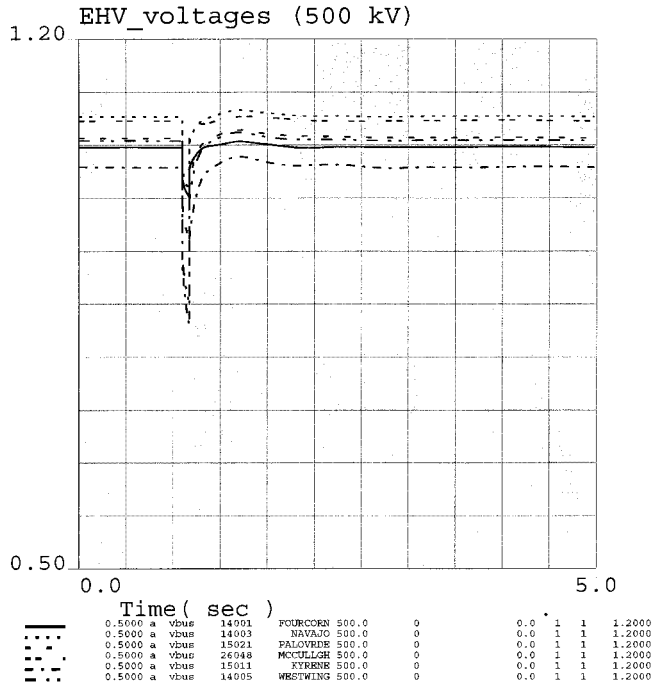

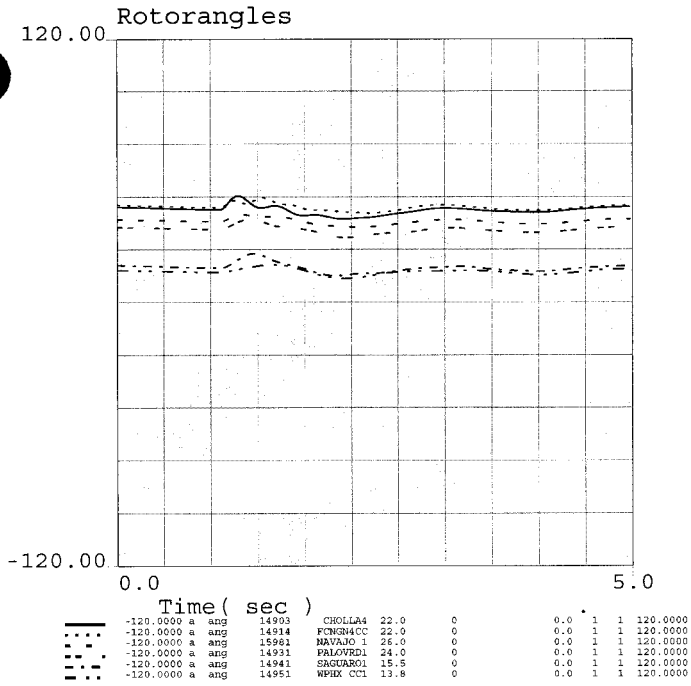

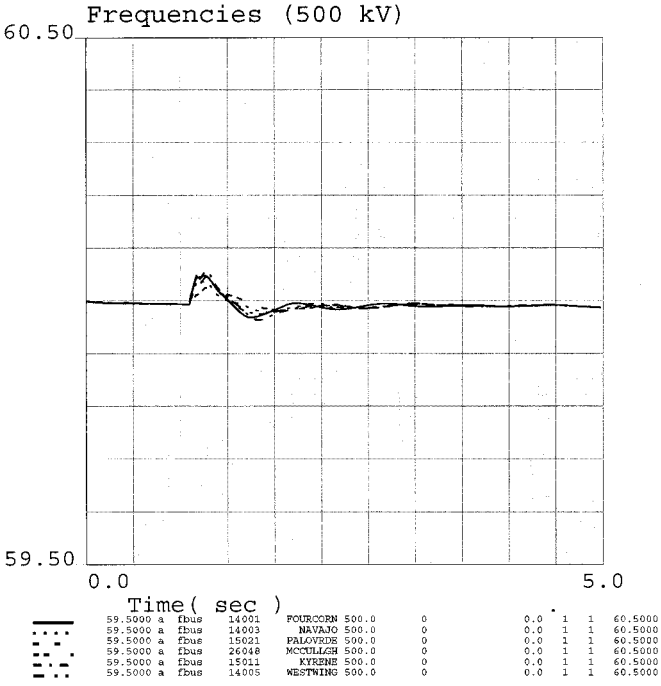

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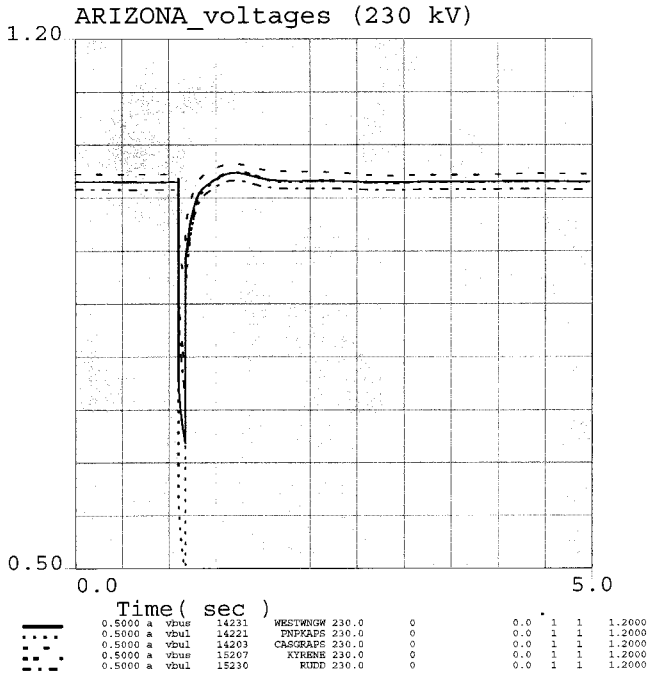

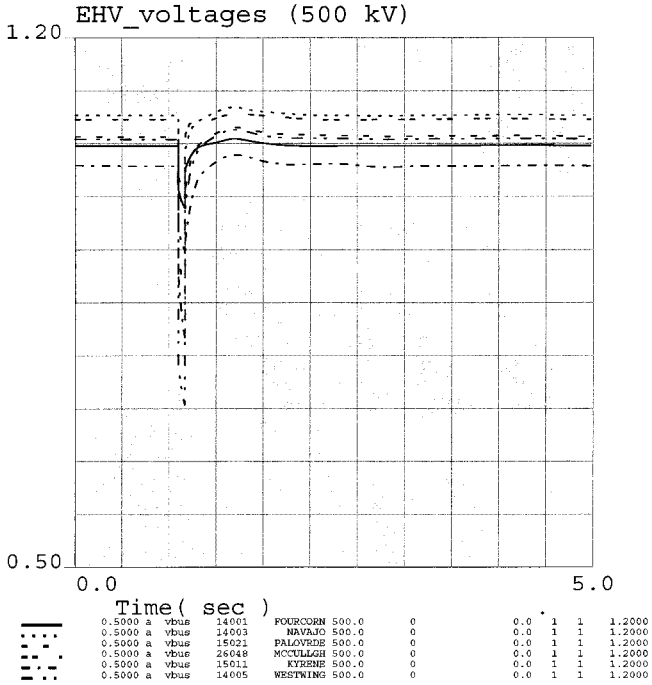

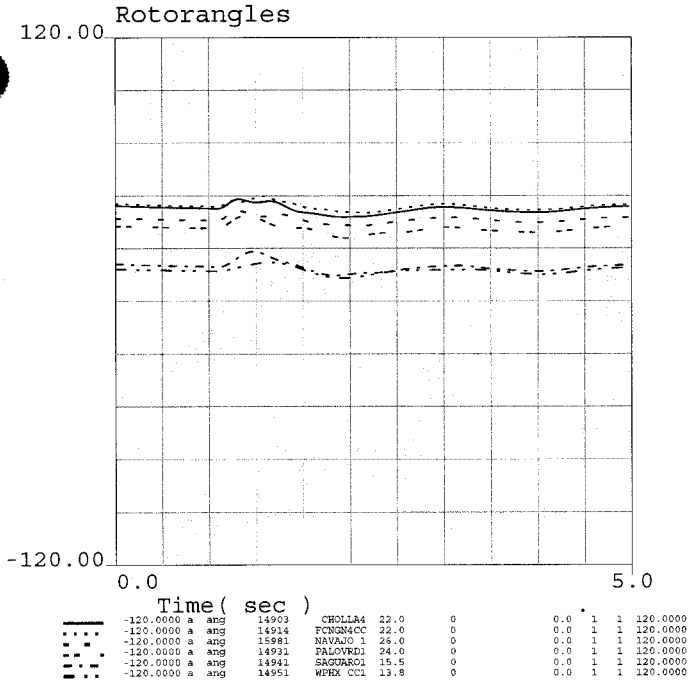

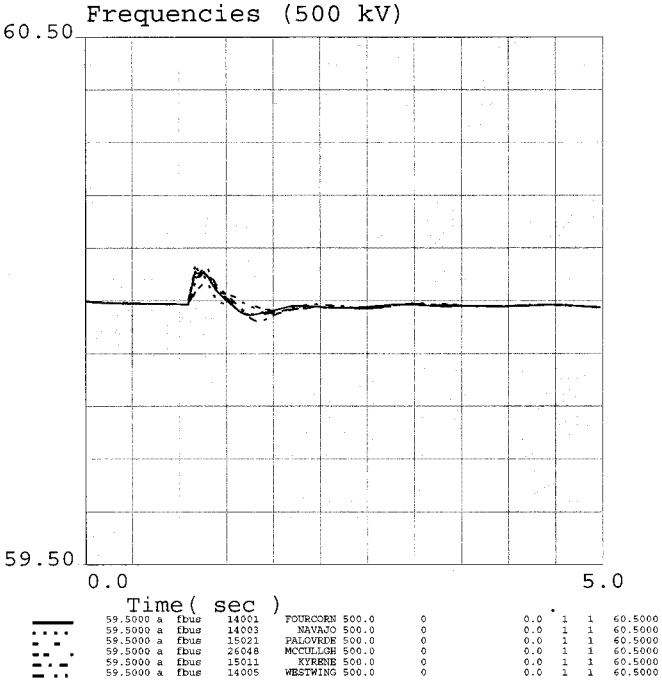

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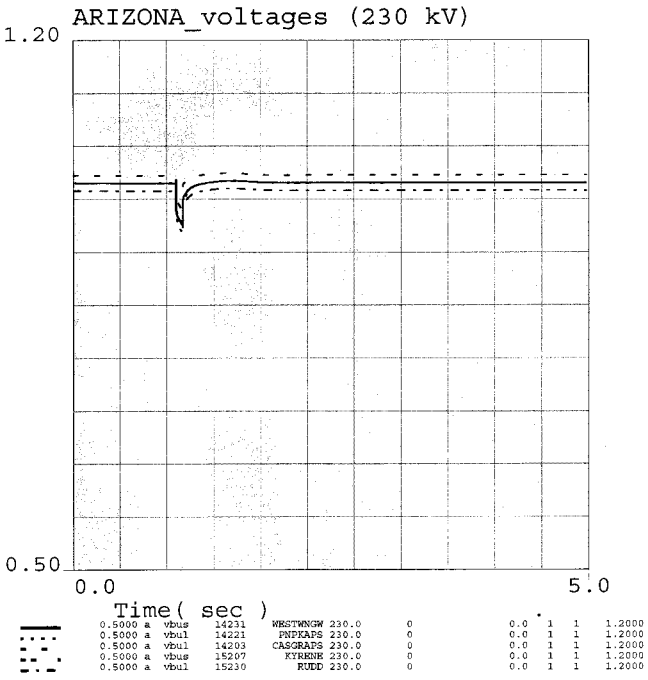

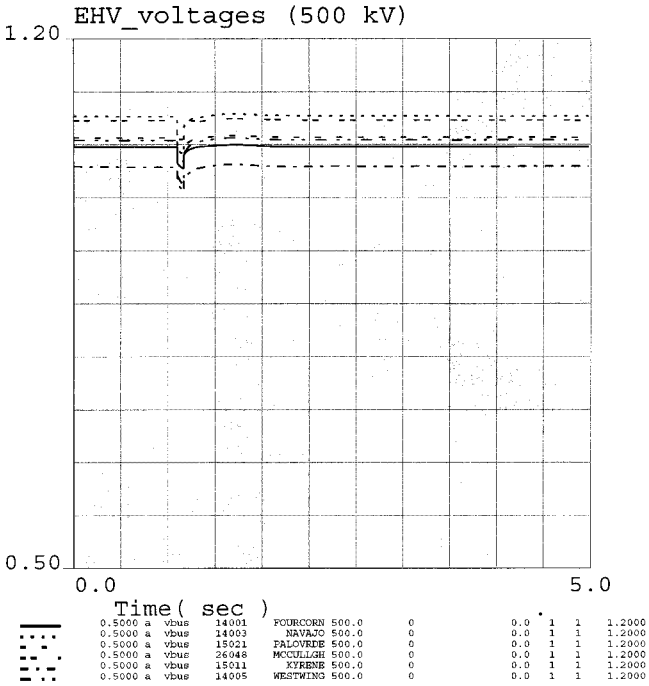

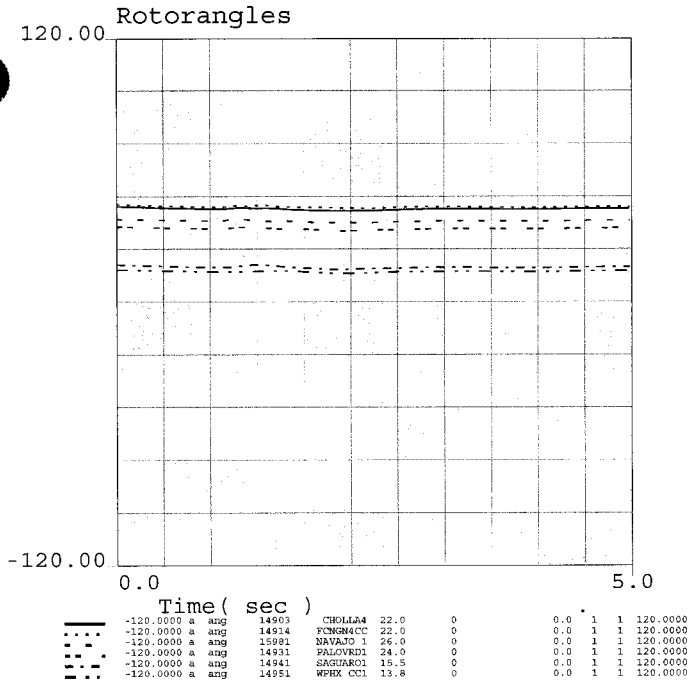

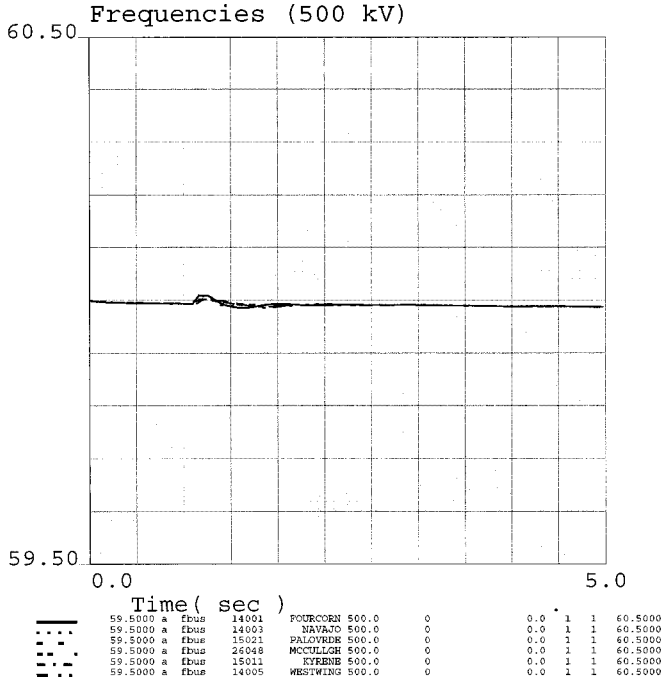

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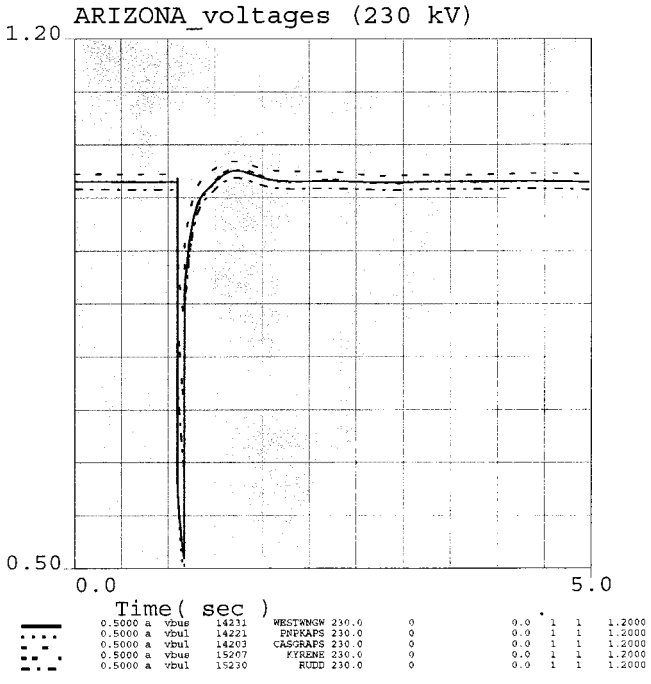

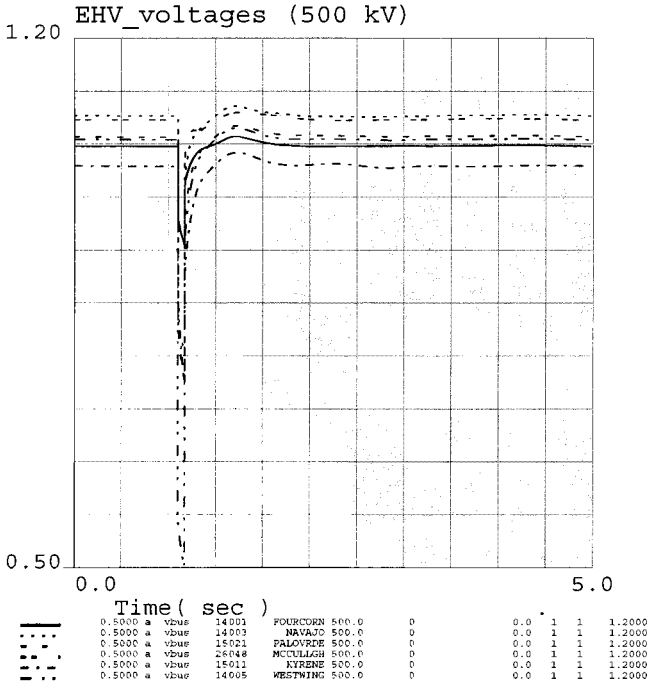

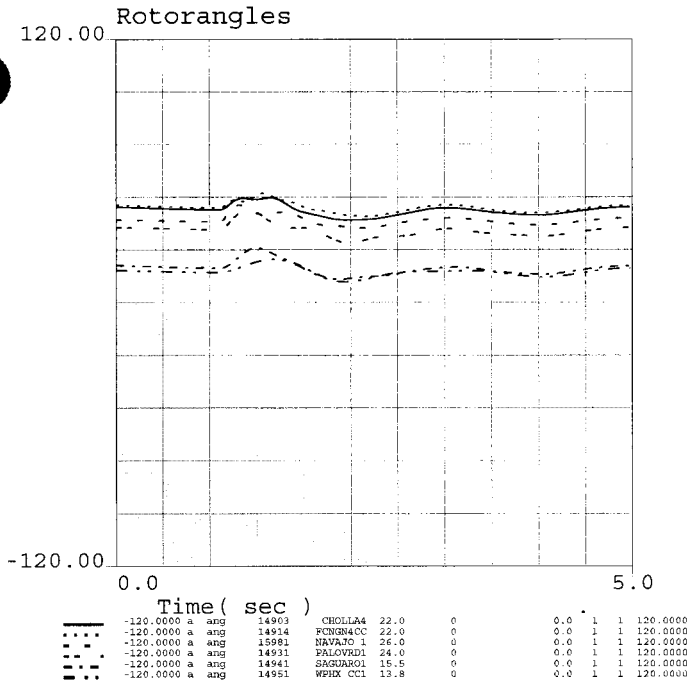

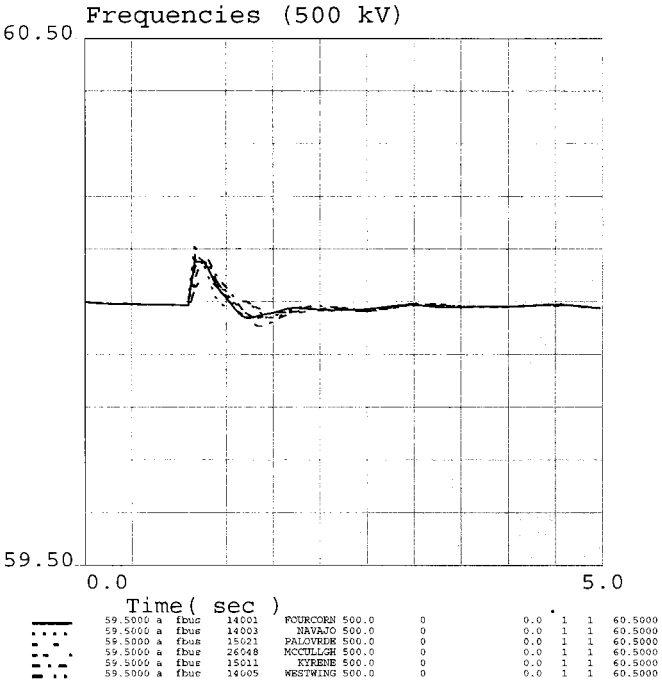

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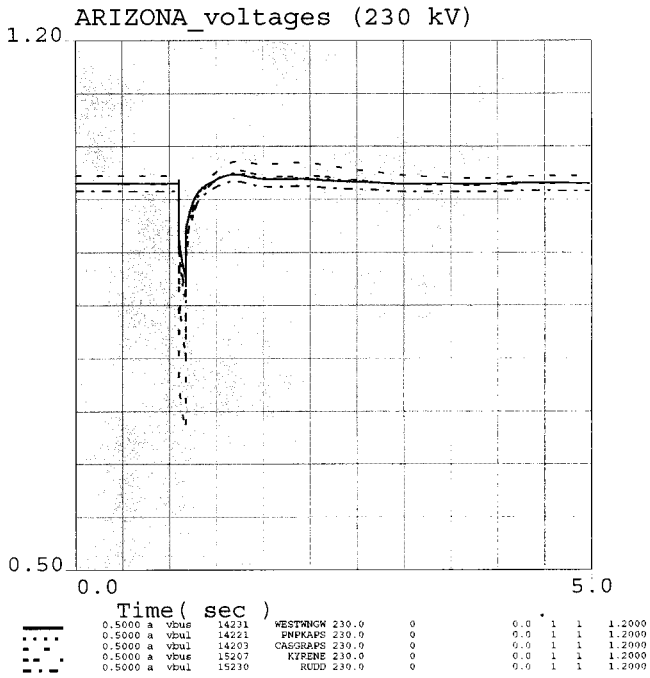

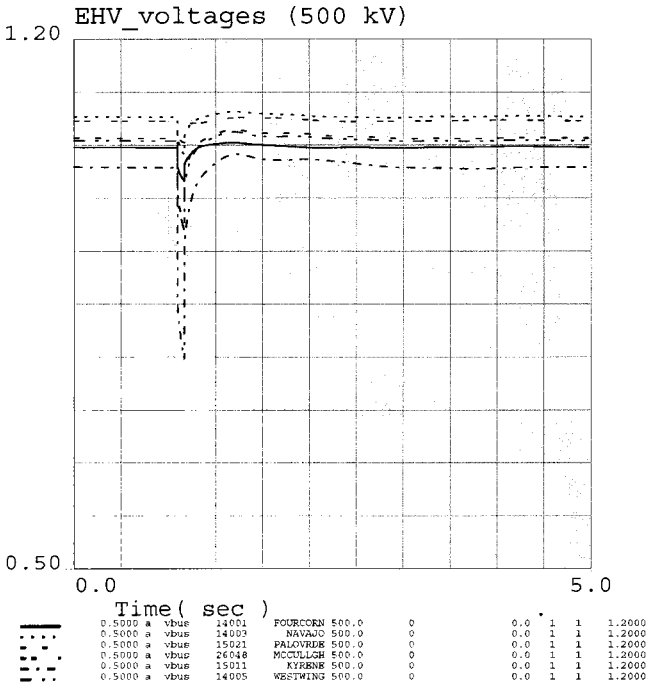

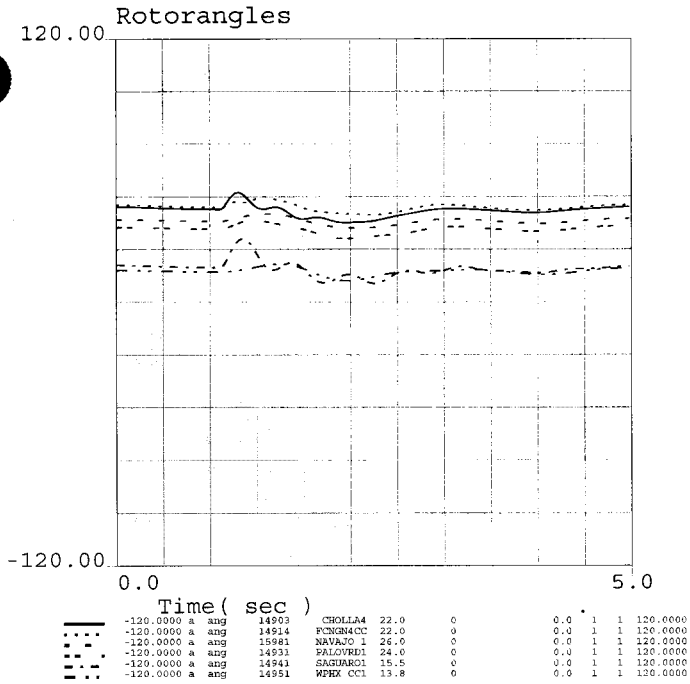

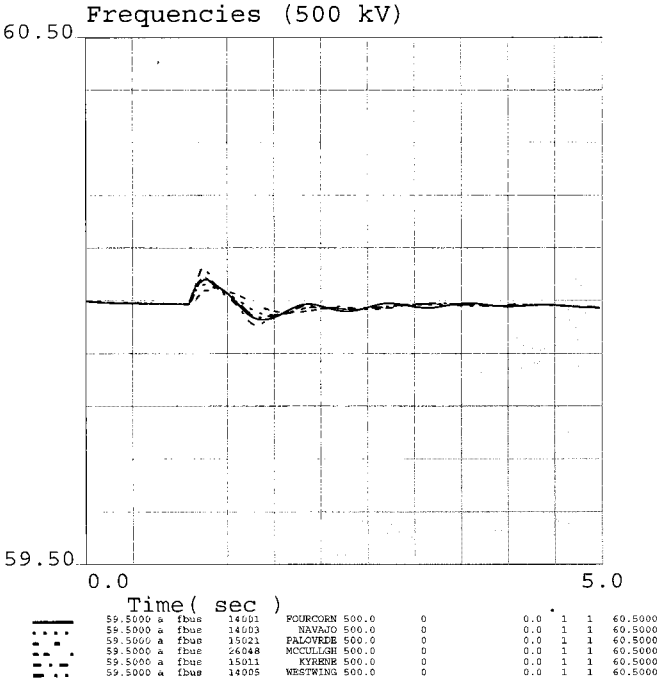

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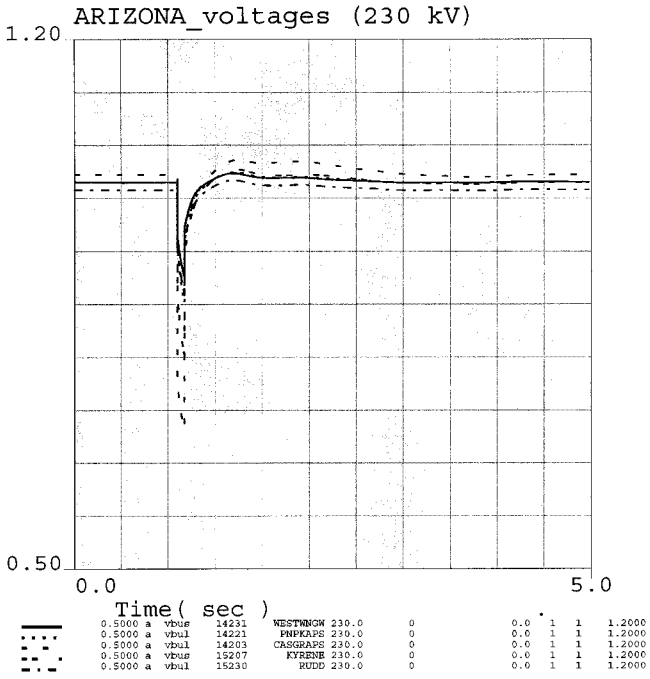

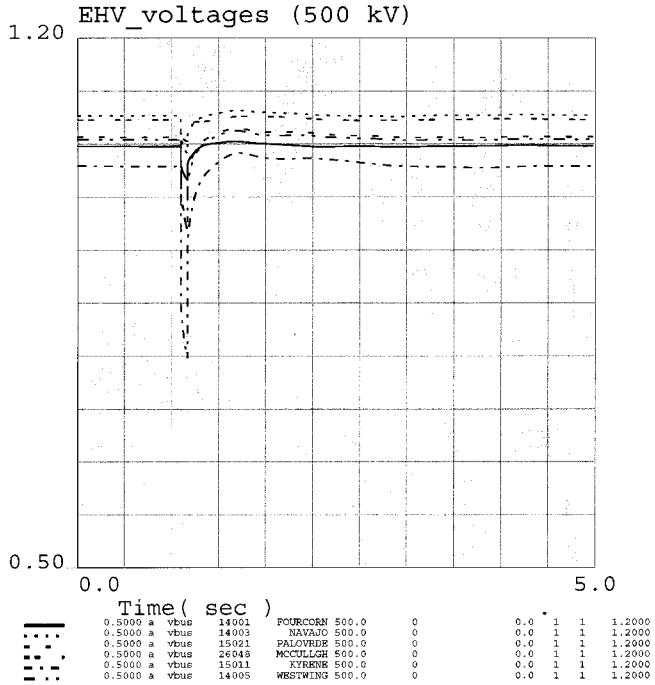

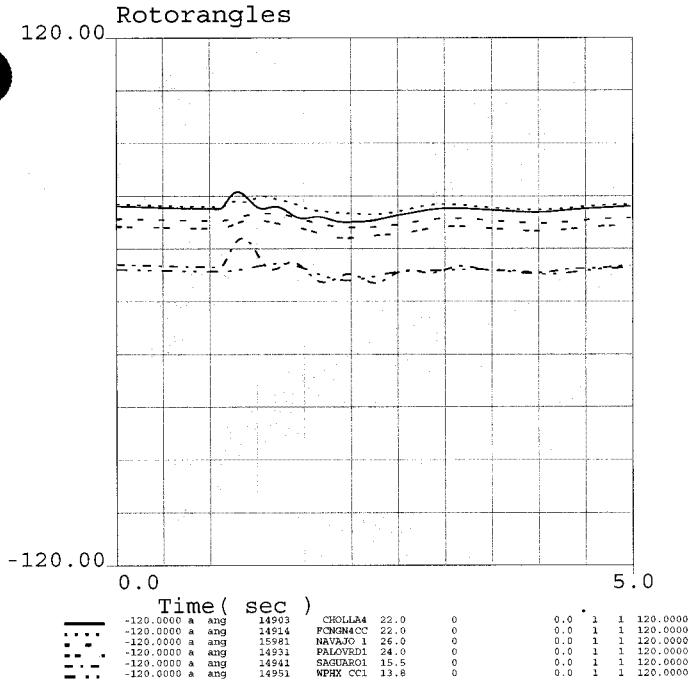

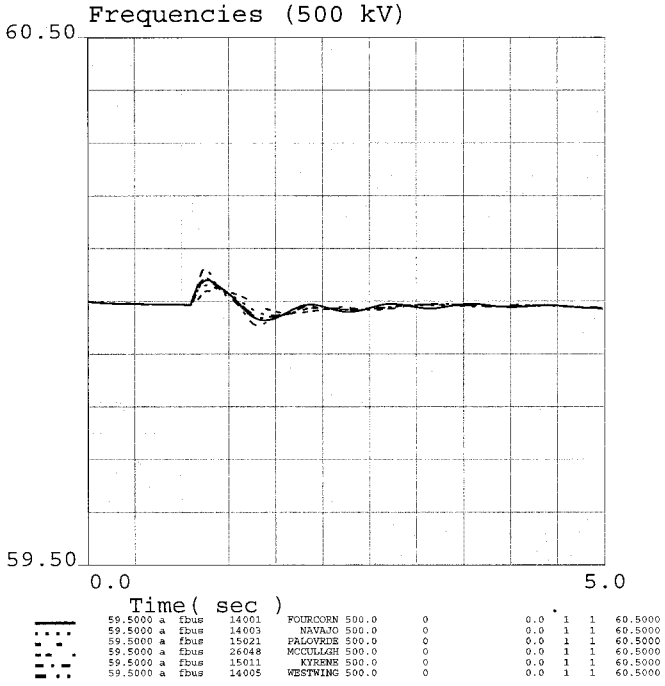

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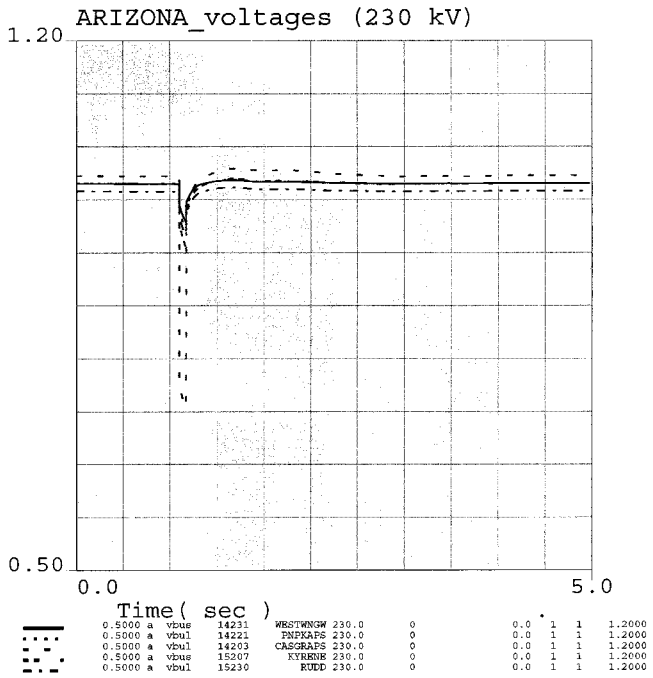

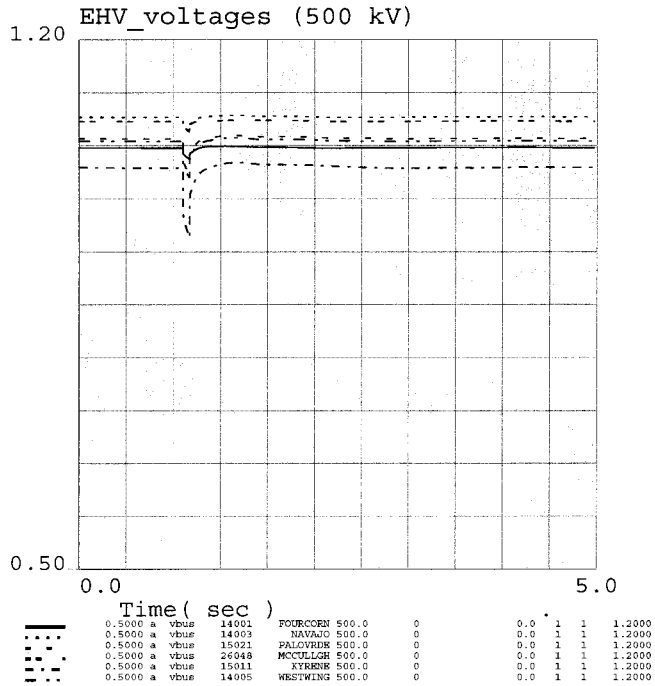

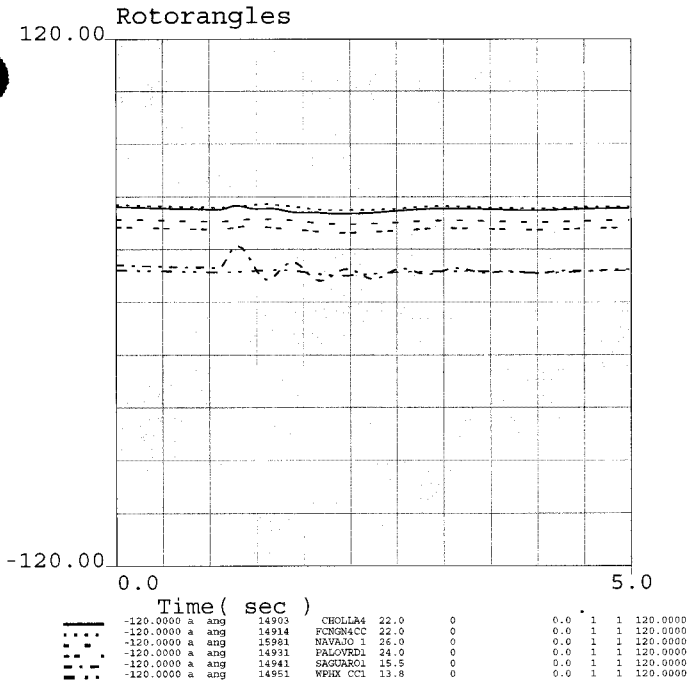

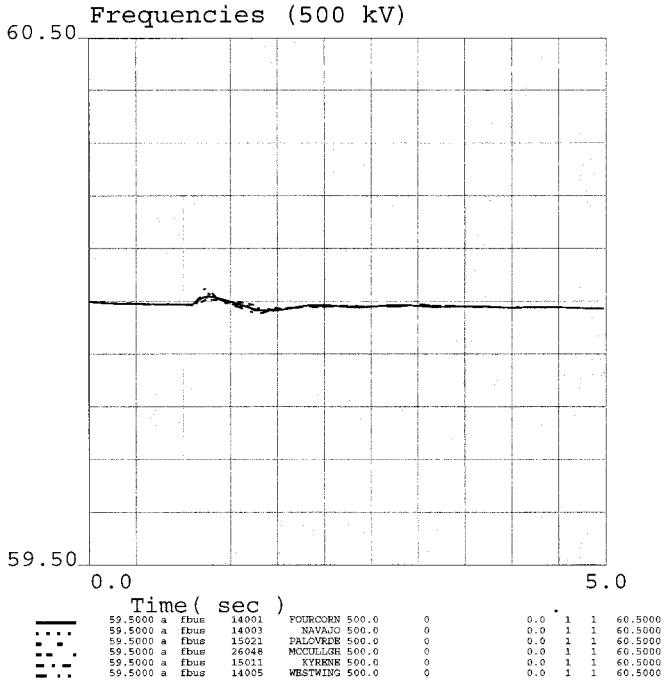

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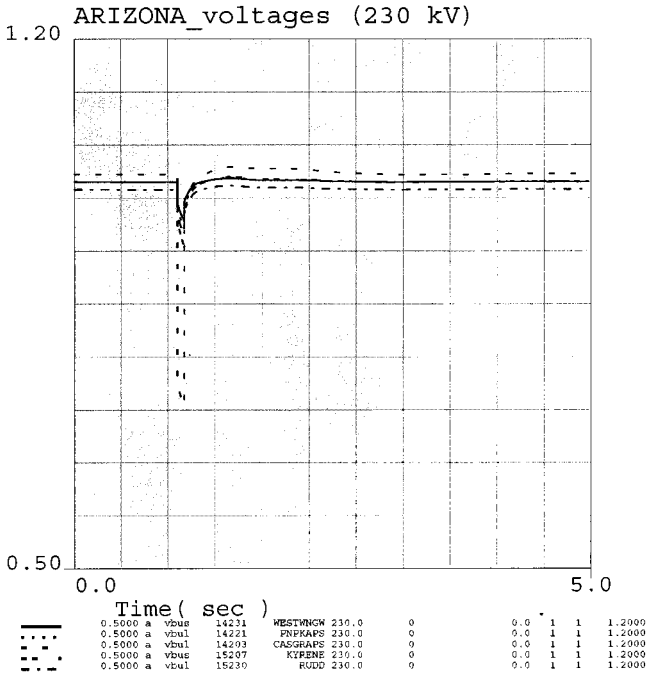

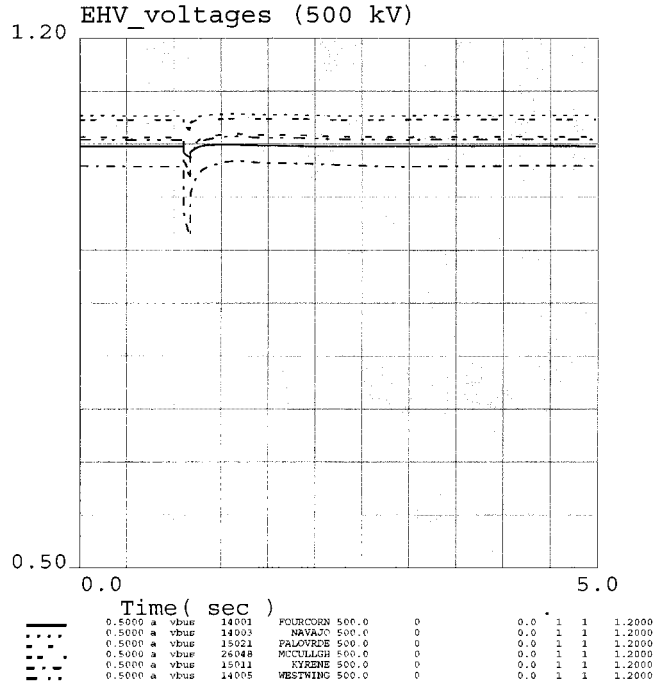

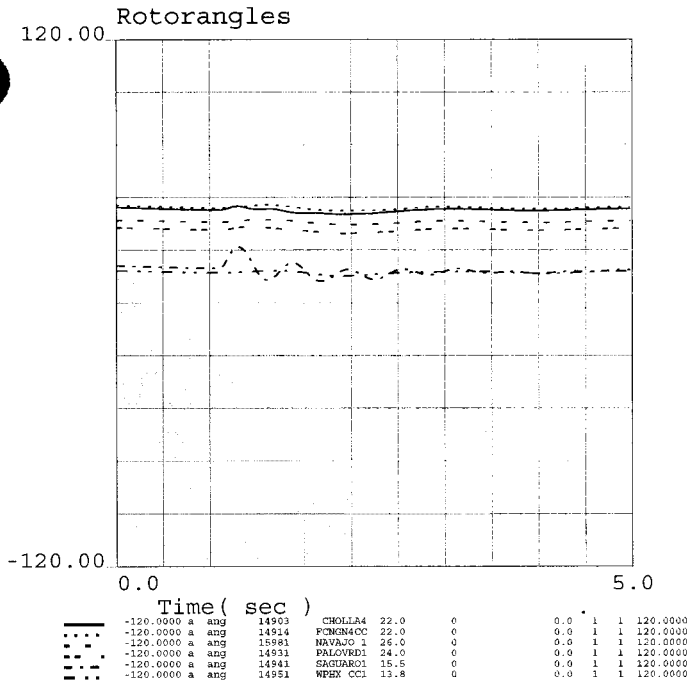

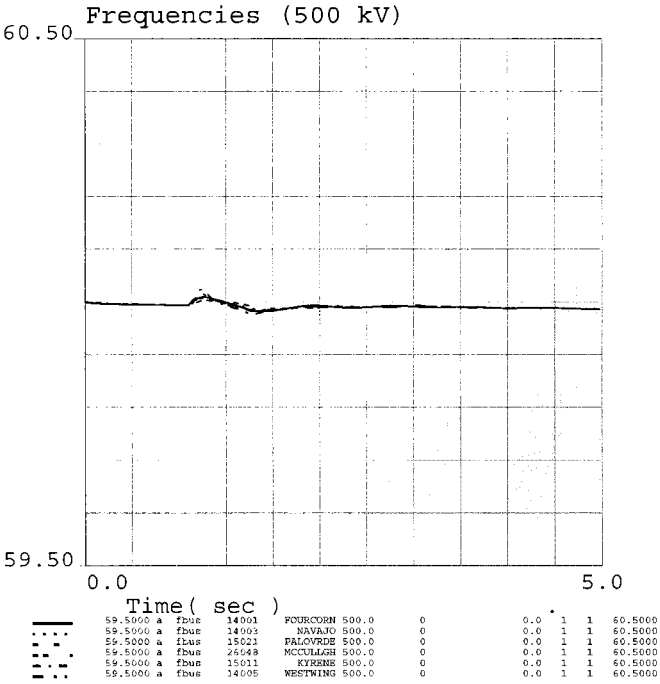

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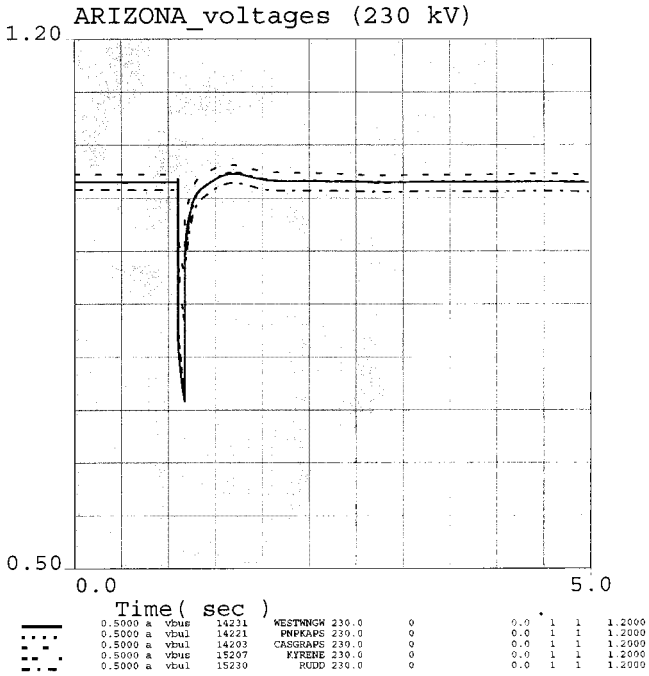

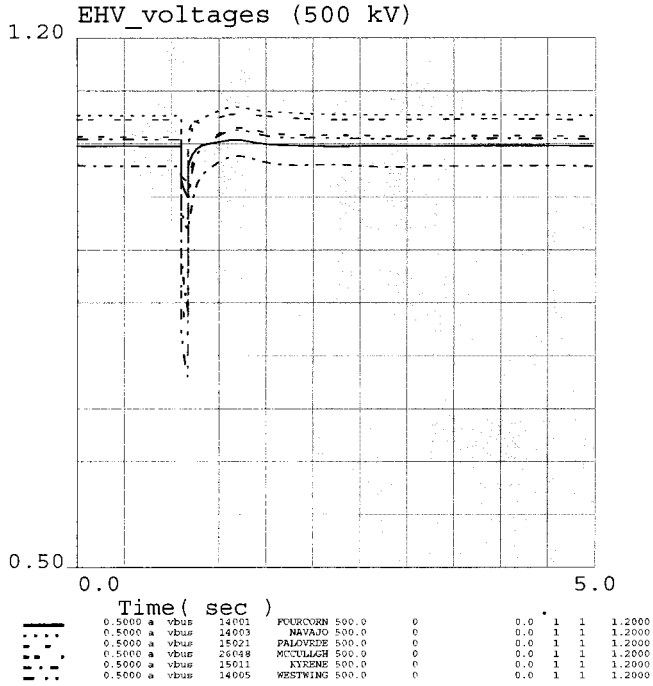

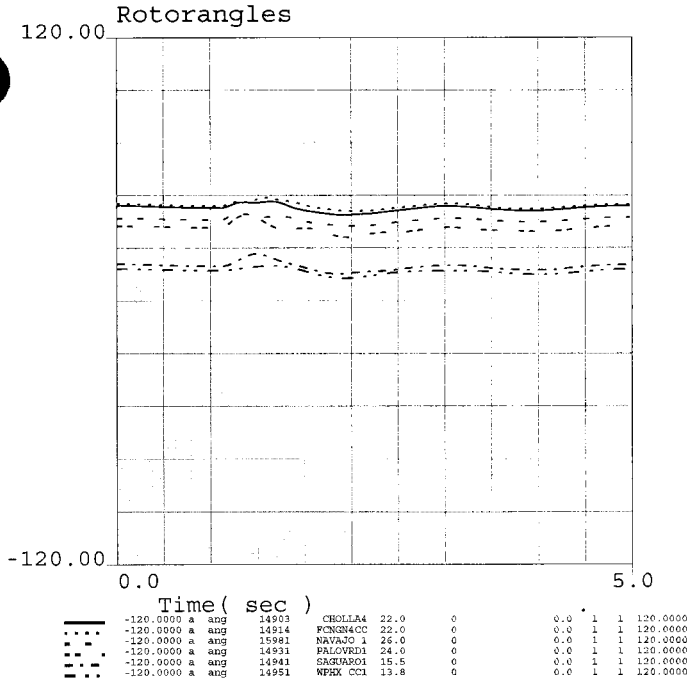

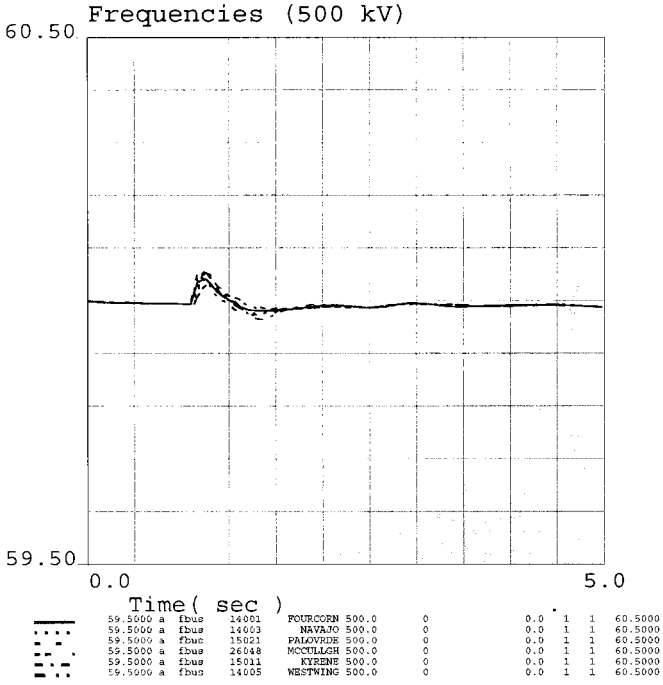

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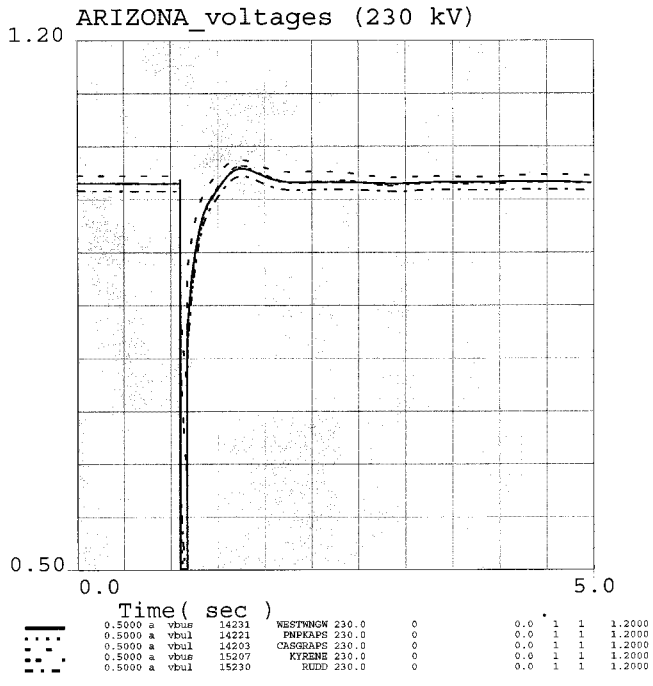

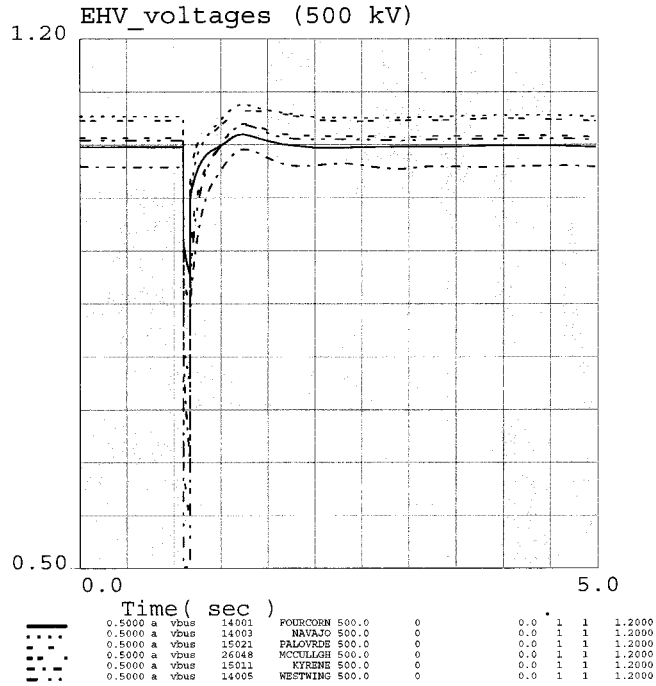

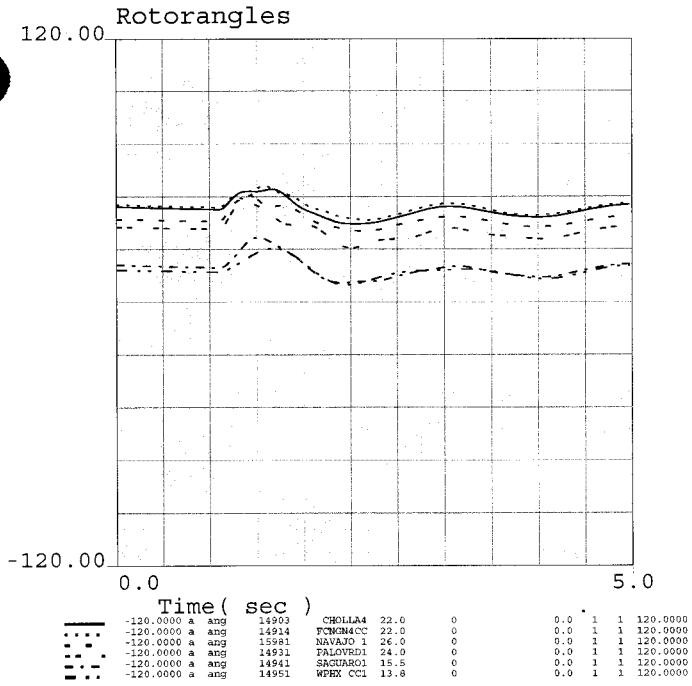

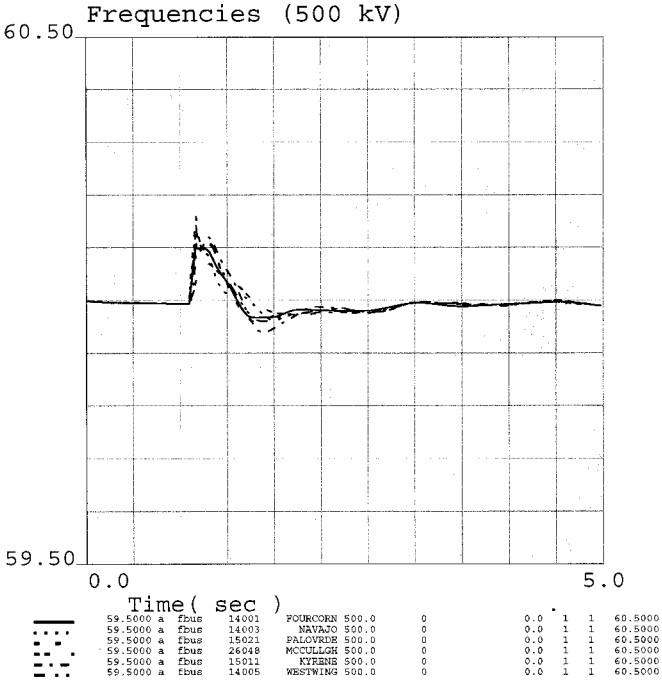

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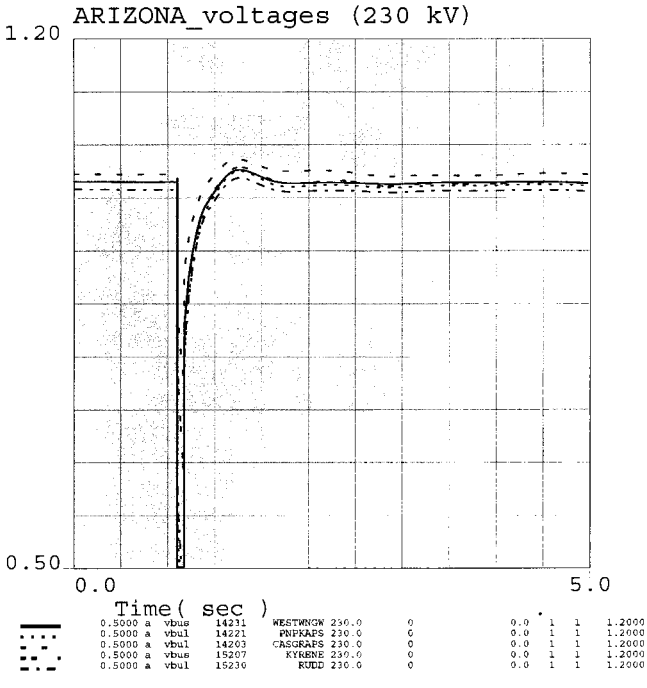

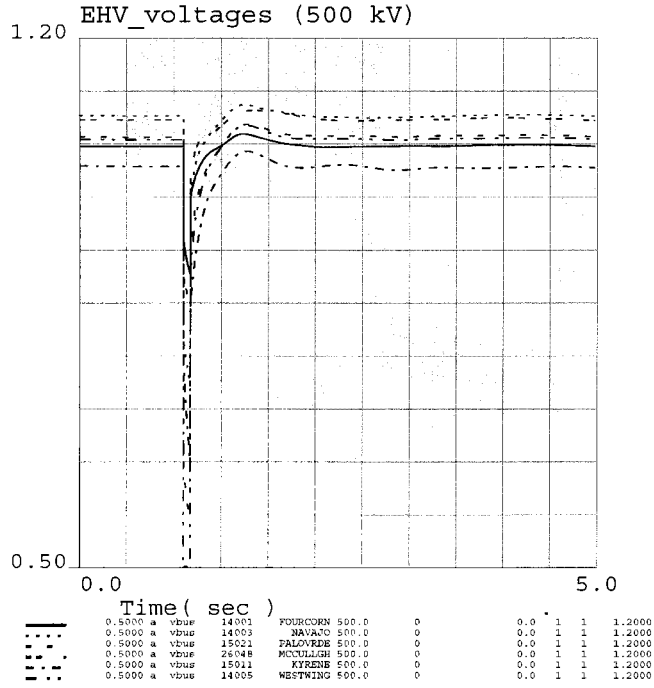

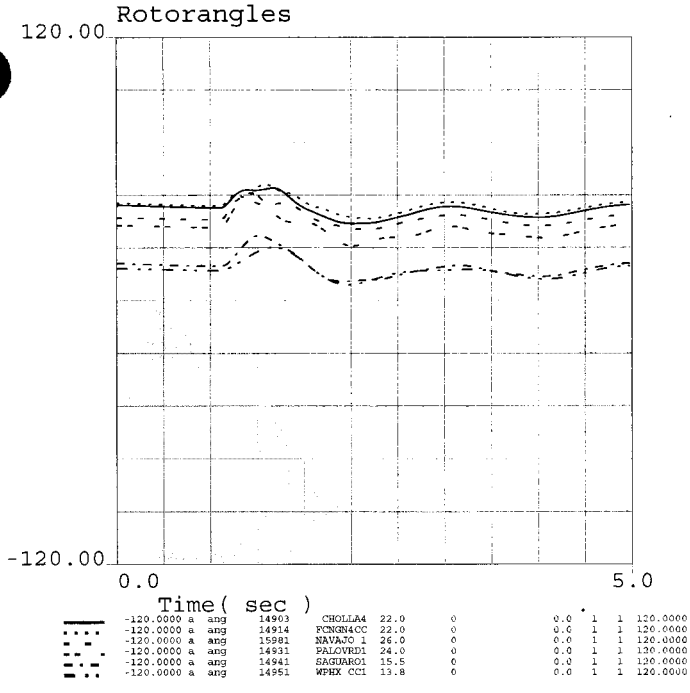

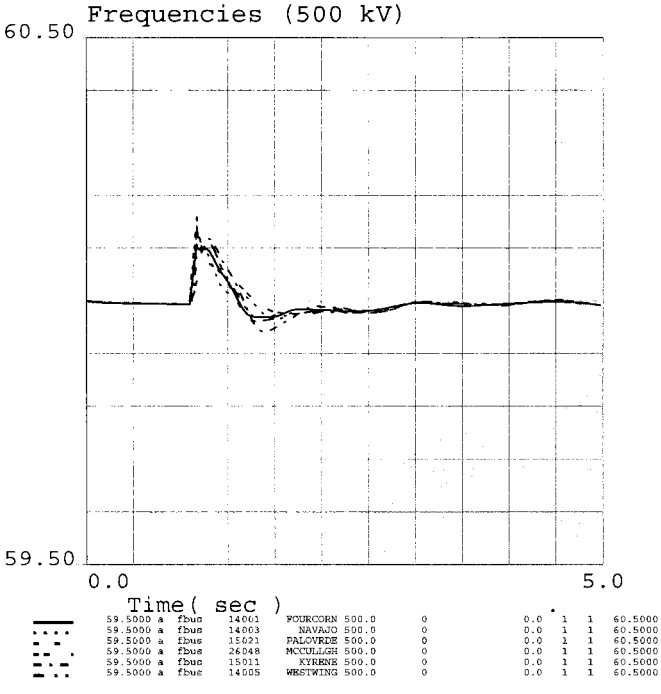

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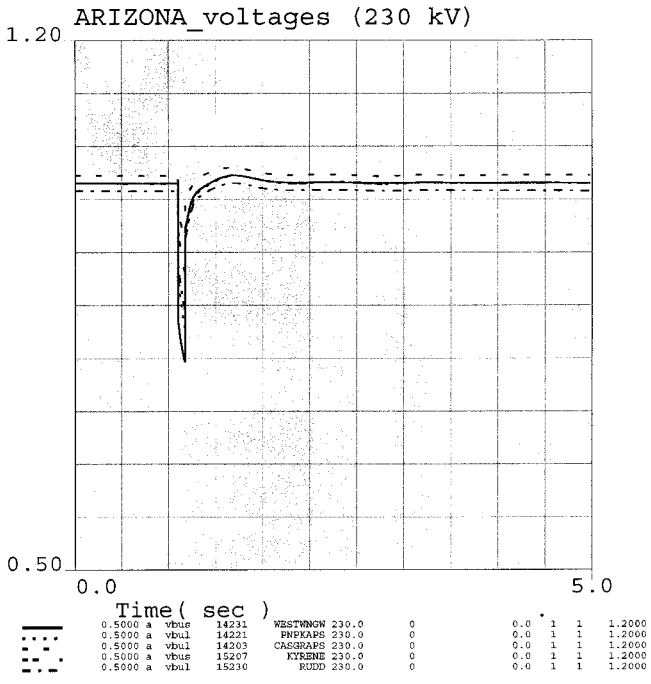

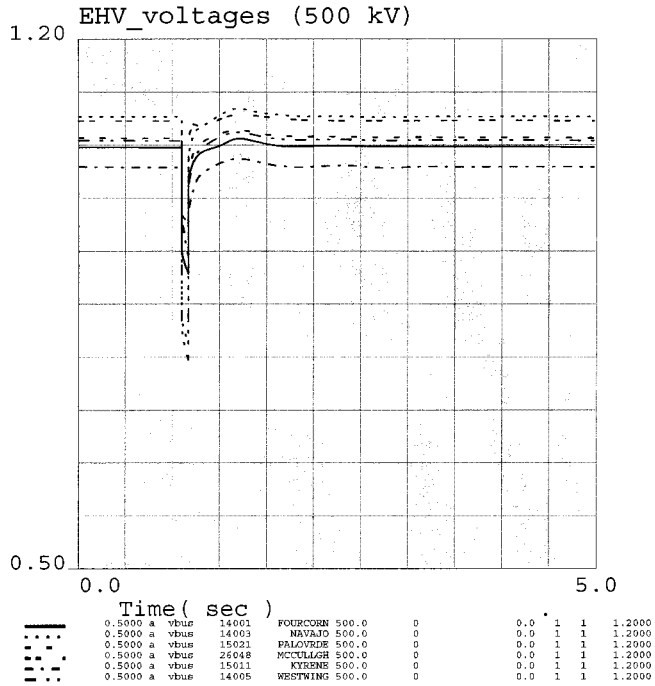

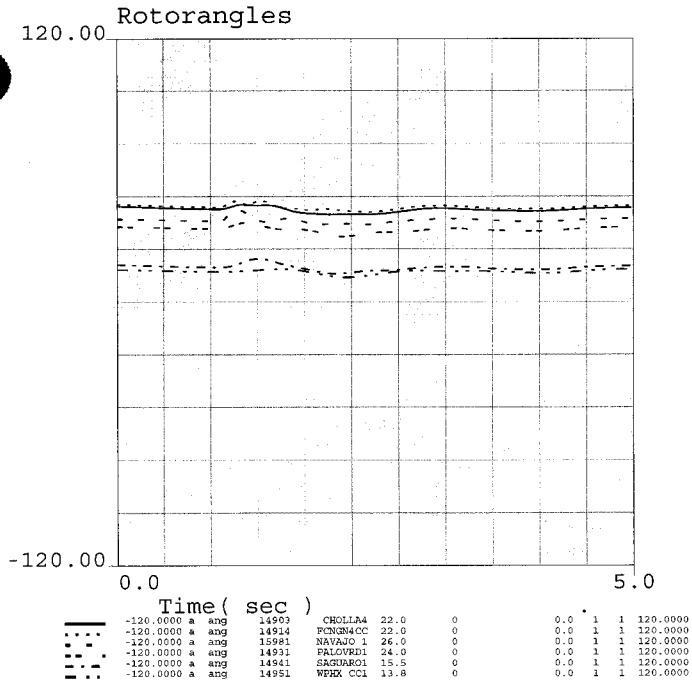

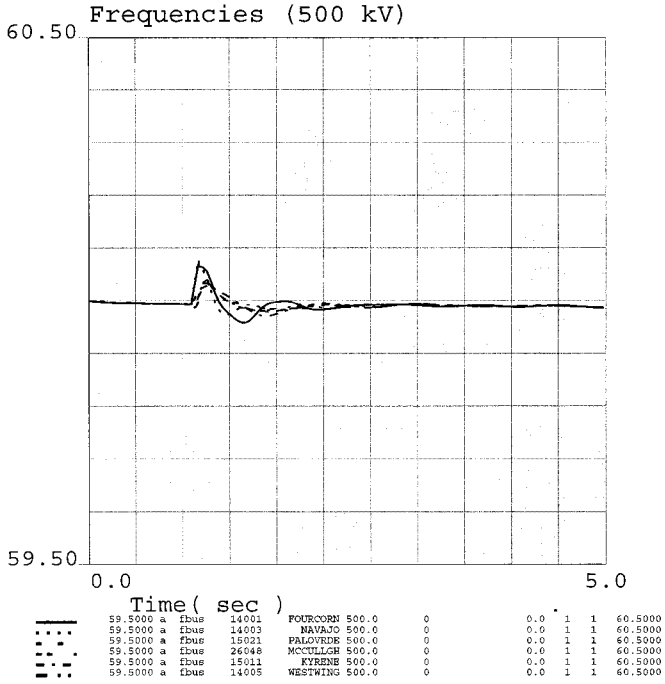

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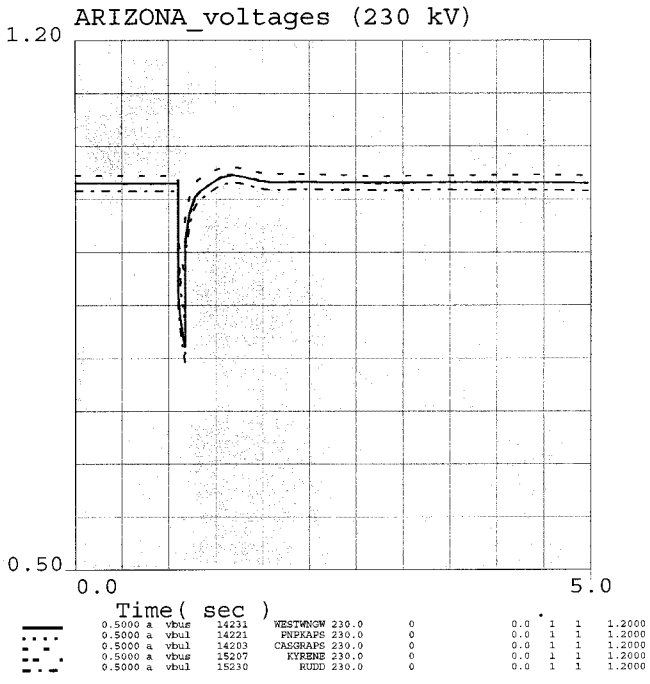

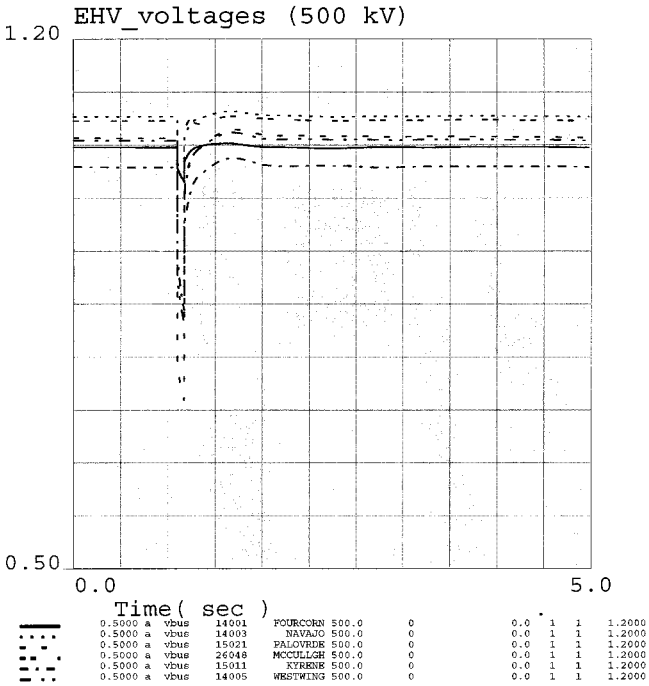

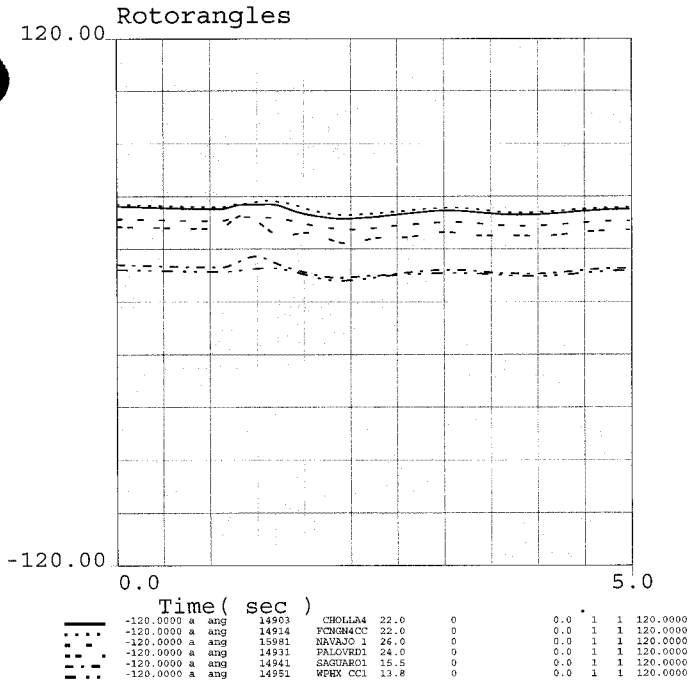

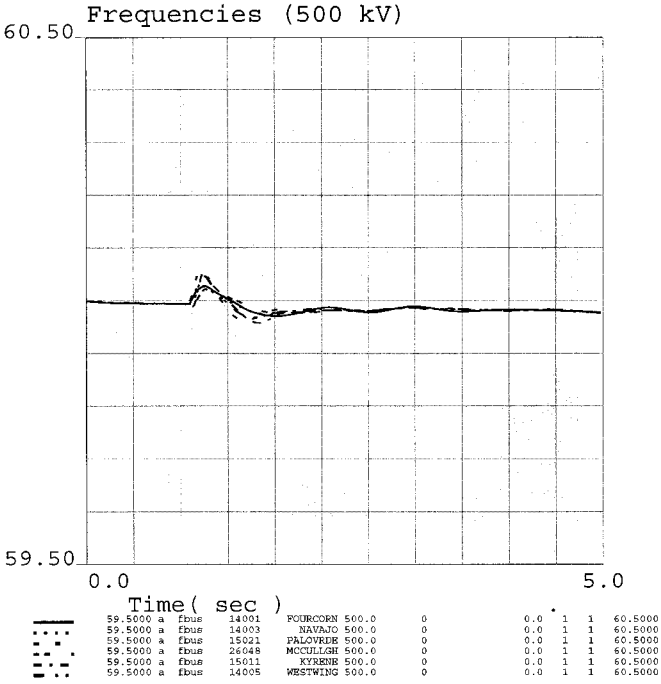

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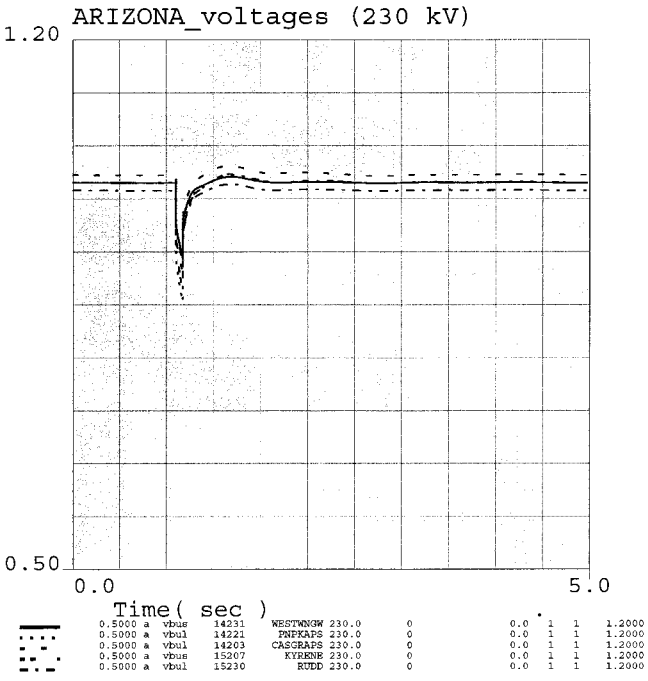

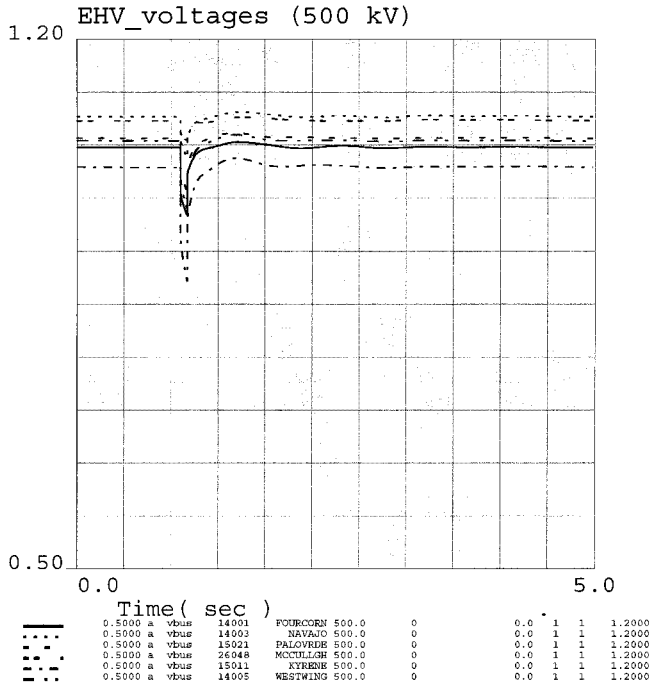

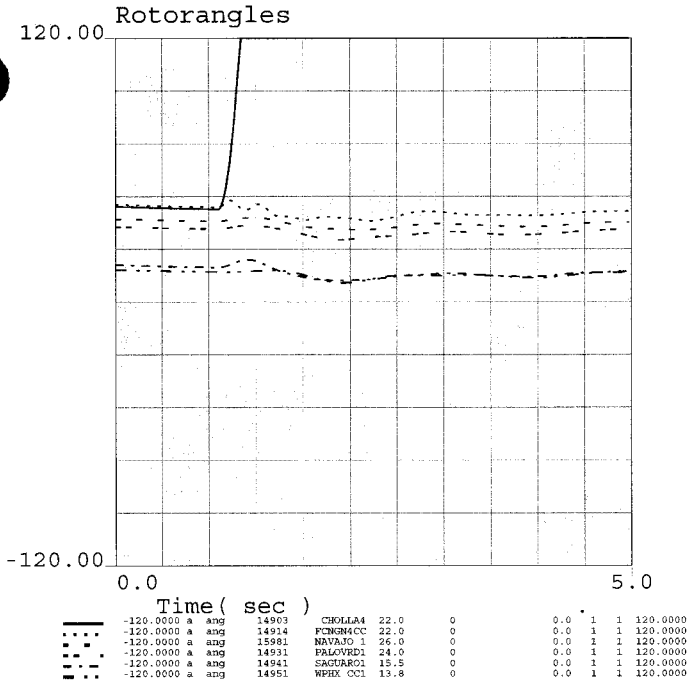

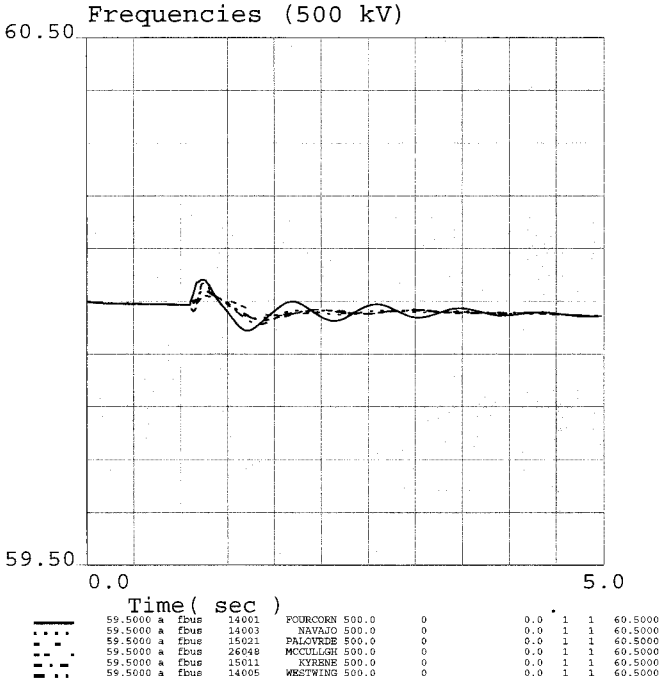

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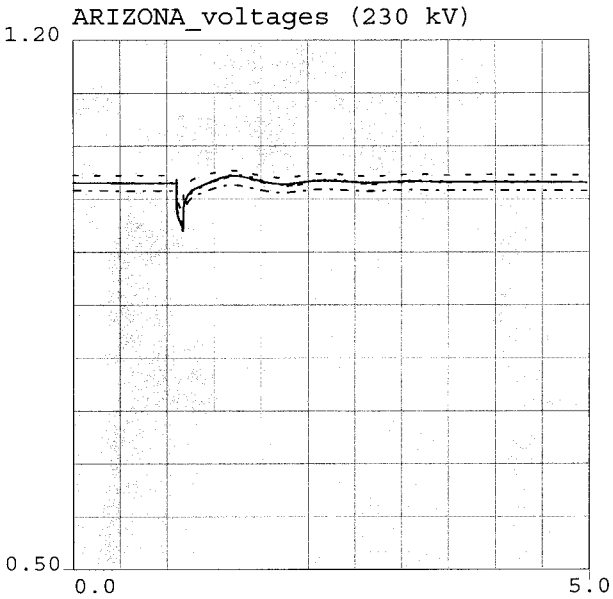

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0.5000	a	vbus	15207	KYRENK	230.0	0	0.0	1	1	1.2000
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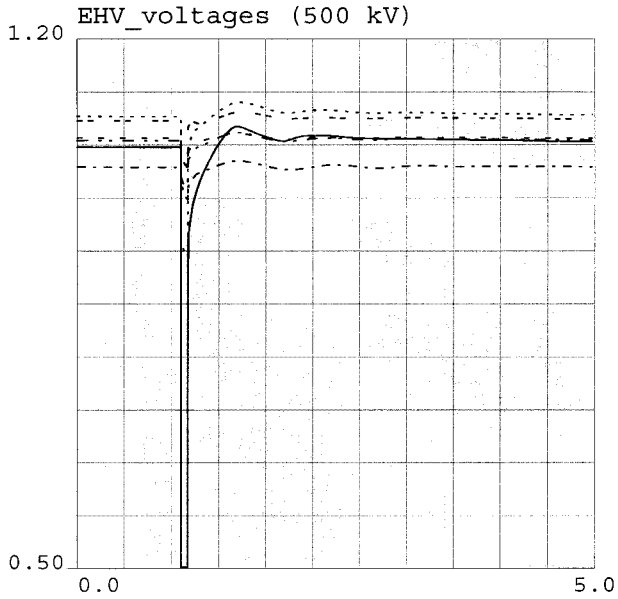

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0.5000	a	vbus	15021	PALOVRDE	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	26048	MCCULLGH	500.0	0	0.0	1	1	1.2000
0.5000	a	vbus	15011	KYRENE	500.0	0	0.0	1	1	1.2000
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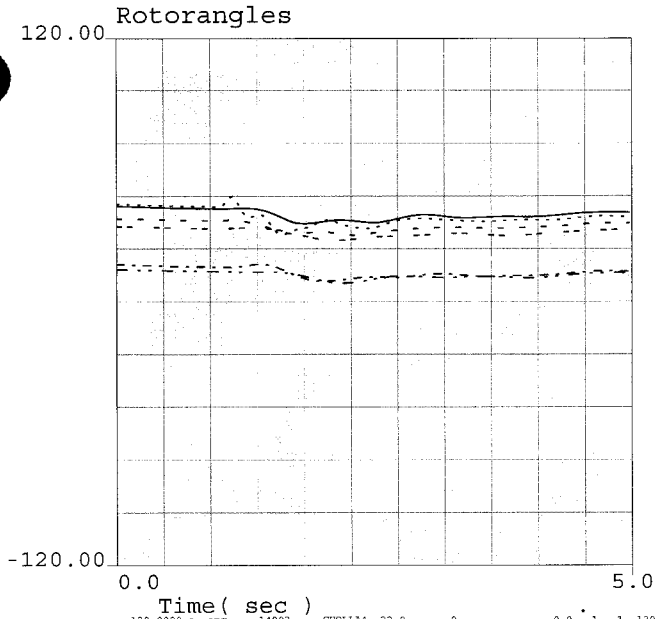

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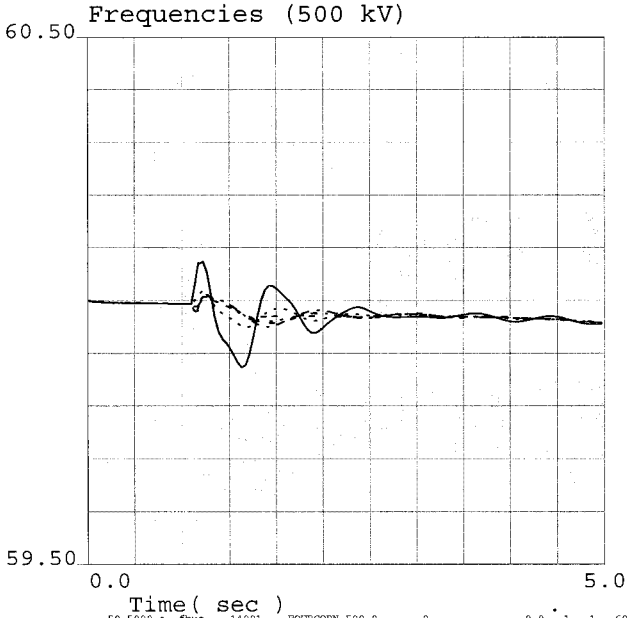

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59.5000	a	fbus	15021	PALOVRDE	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	26048	MCCULLGH	500.0	0	0.0	1	1	60.5000
59.5000	a	fbus	15011	KYRENE	500.0	0	0.0	1	1	60.5000
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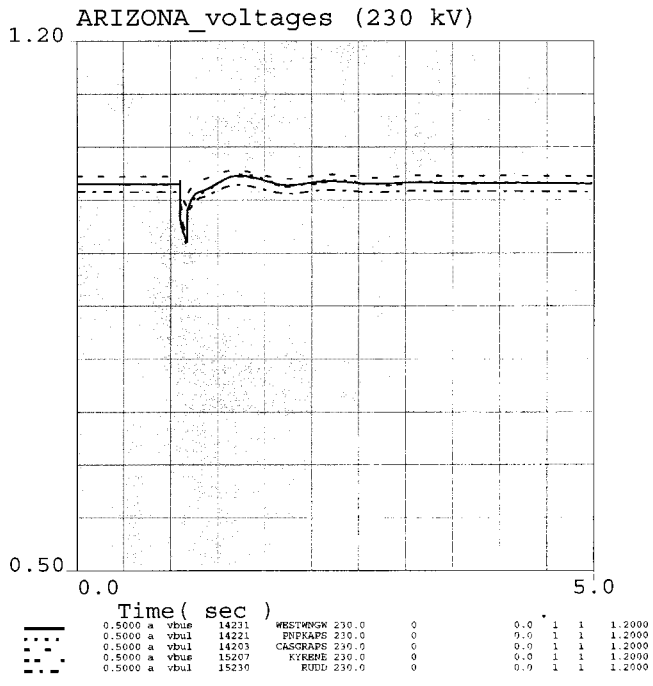

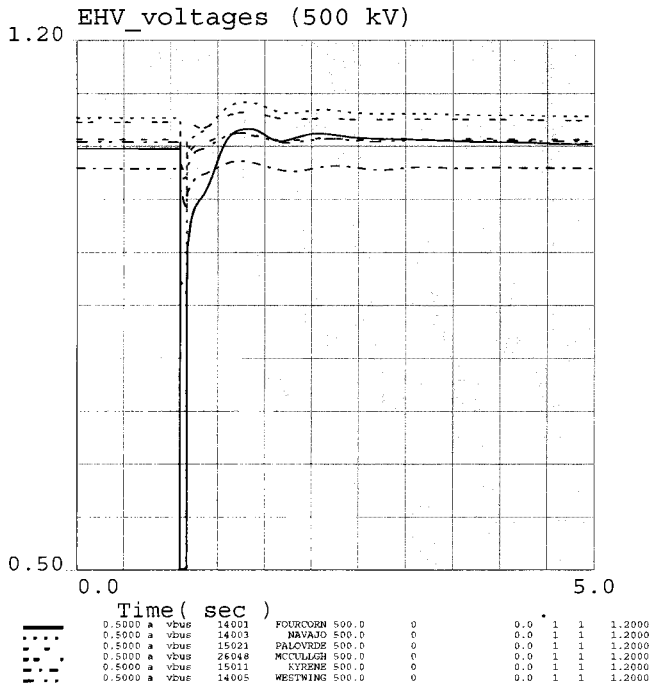

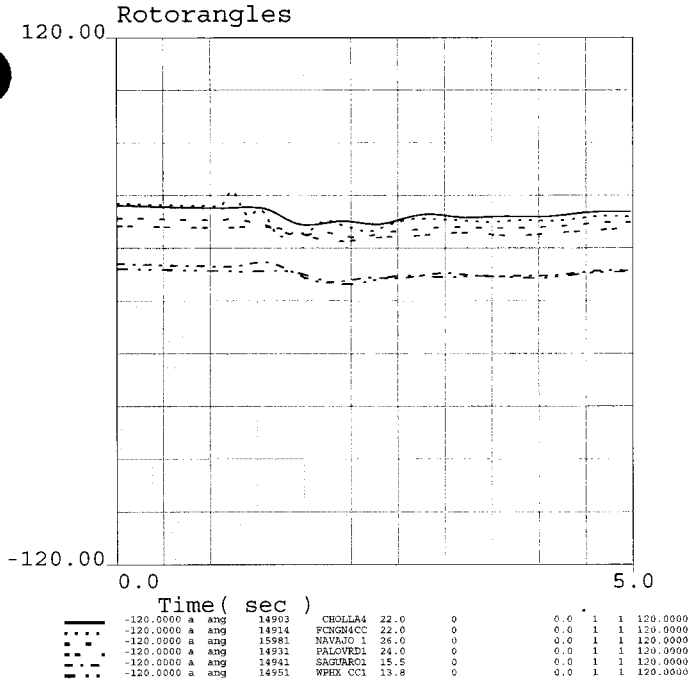

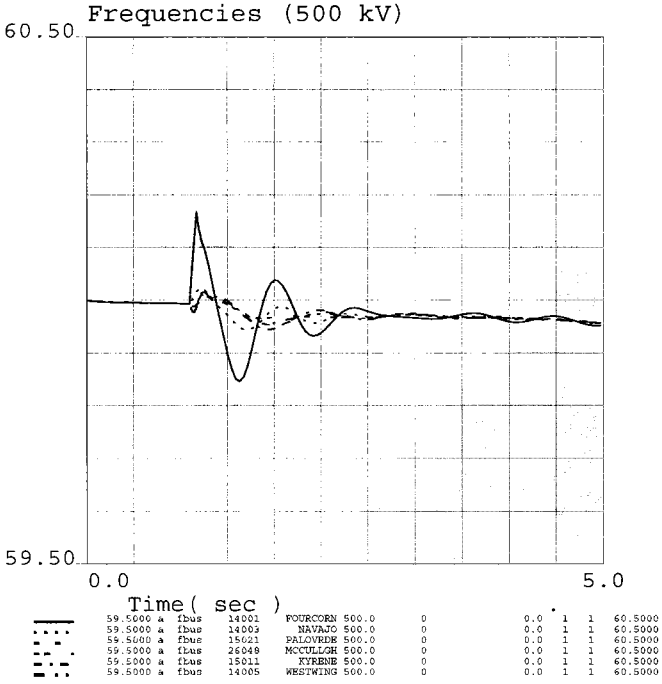

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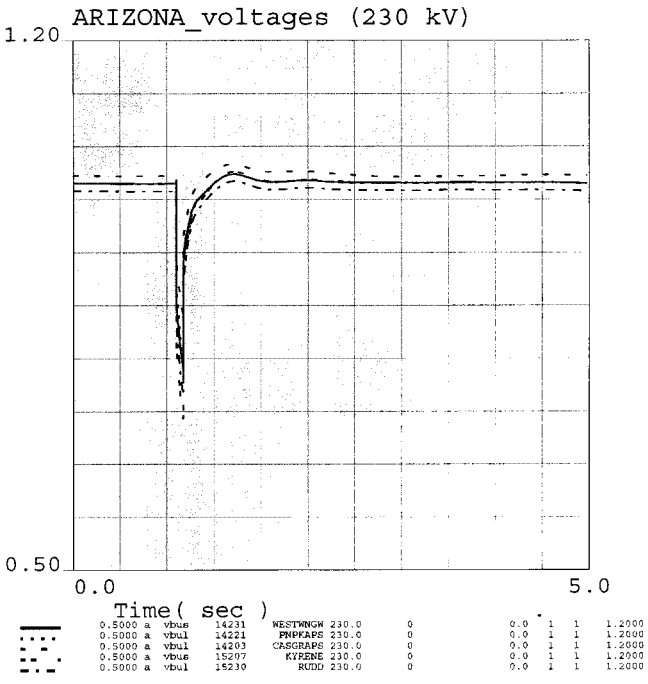

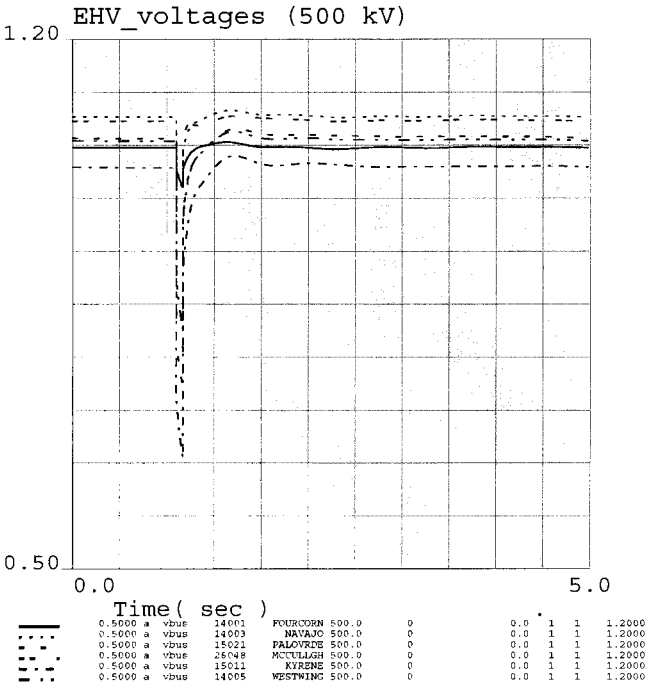

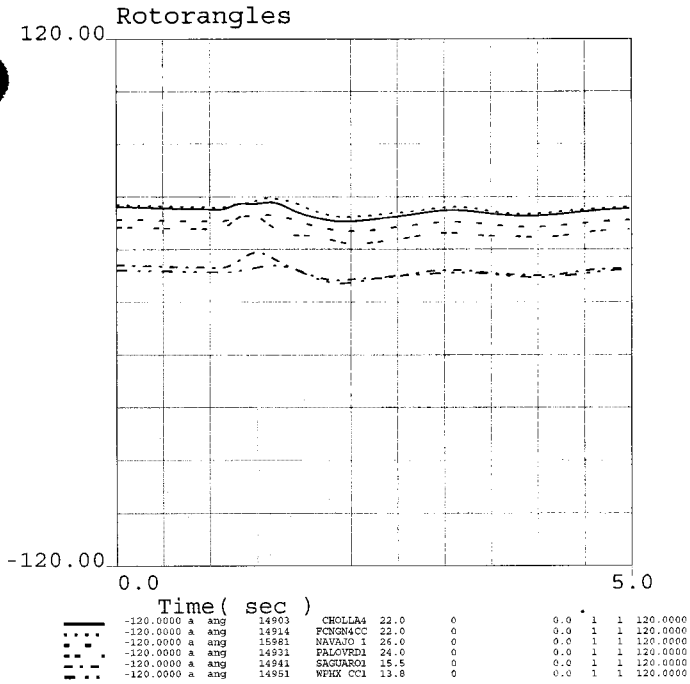

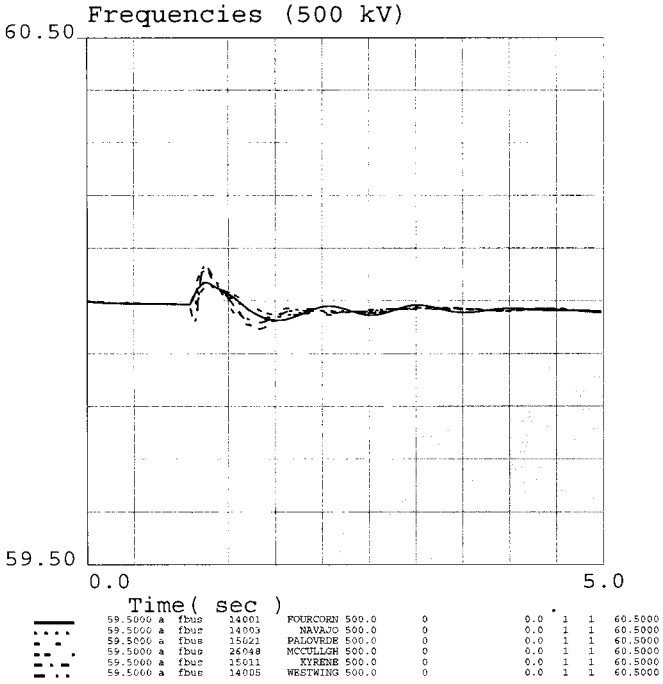

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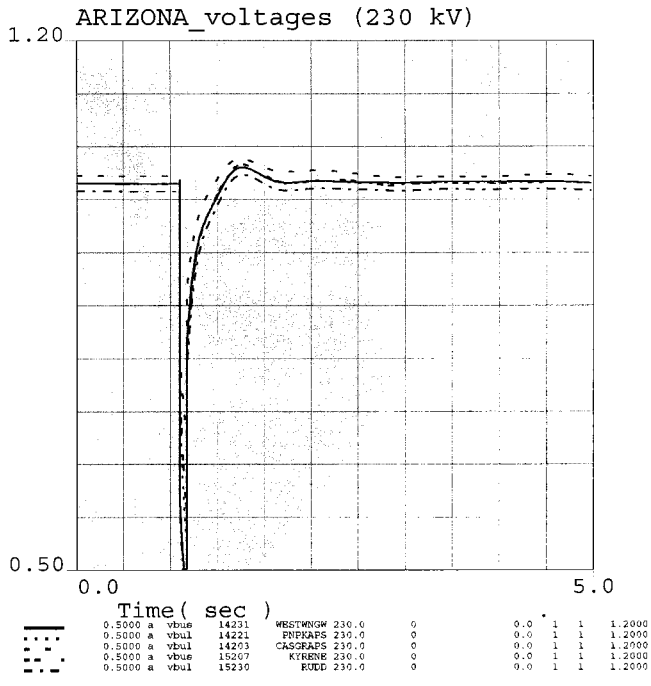

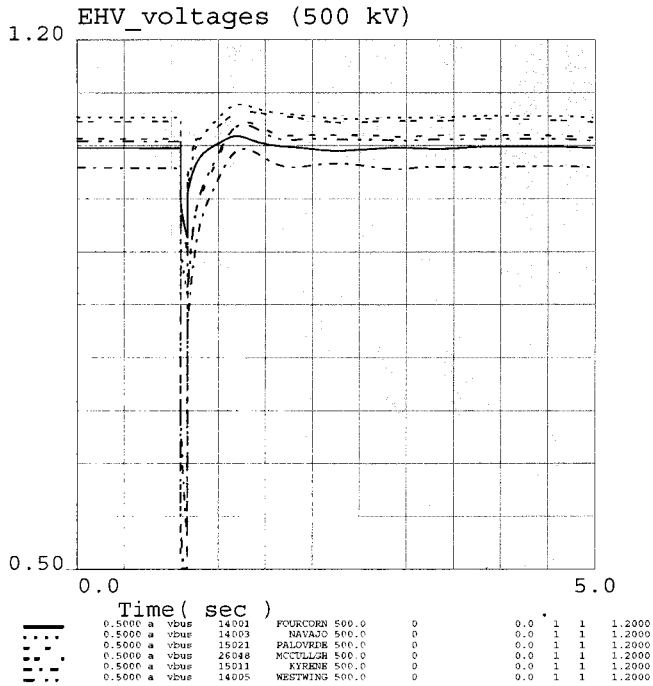

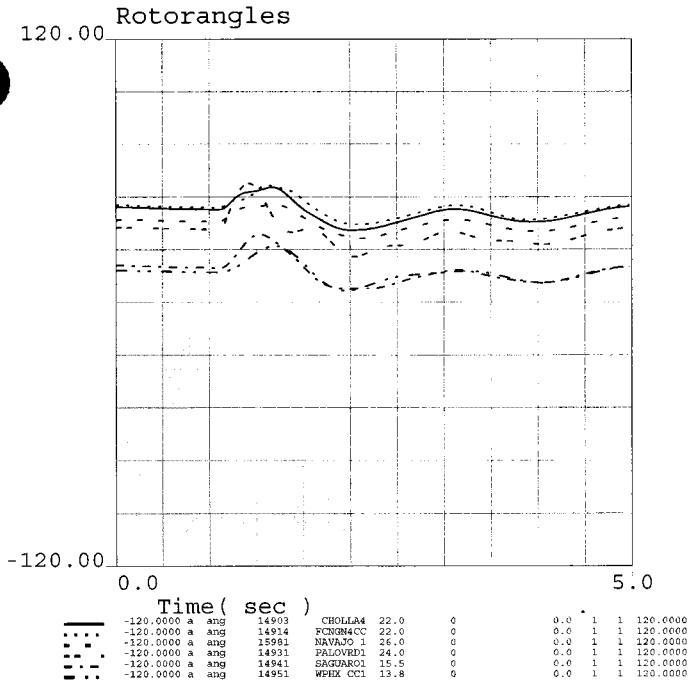

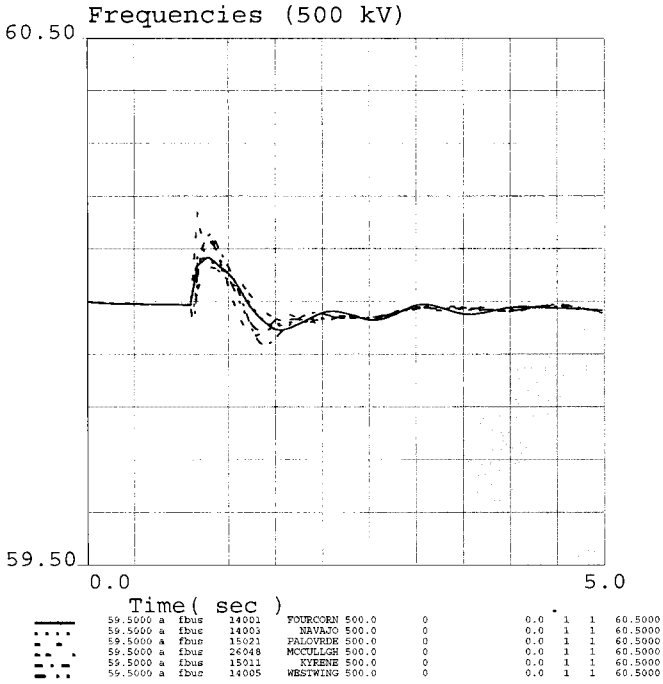

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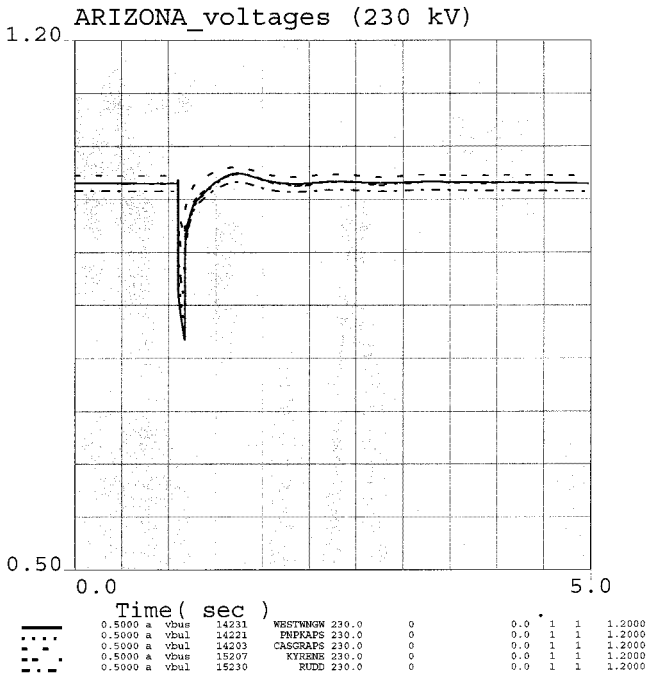

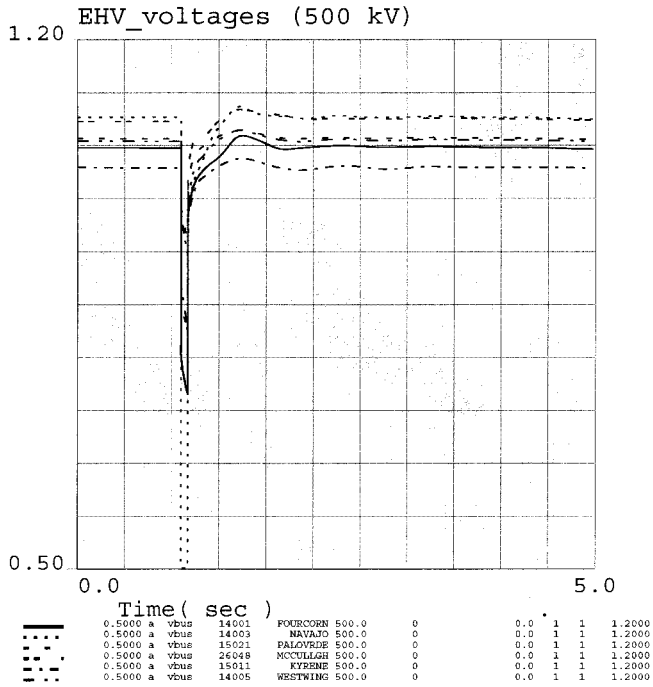

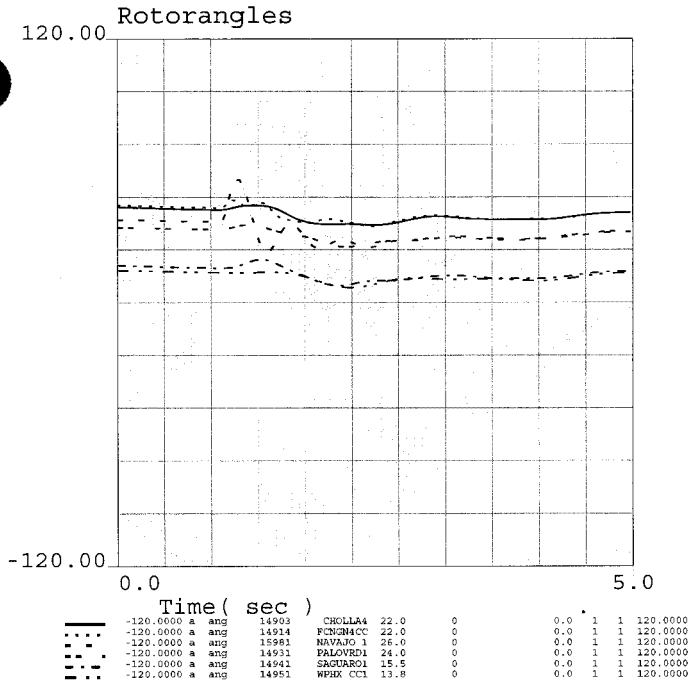

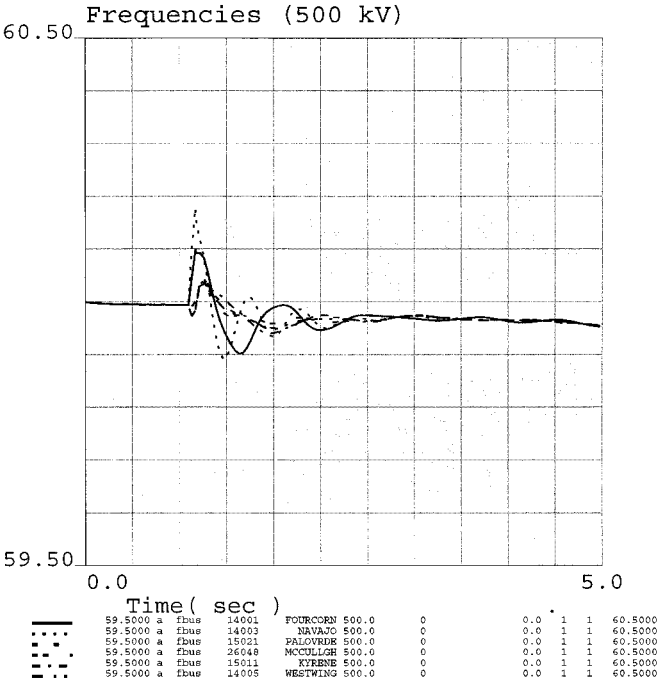

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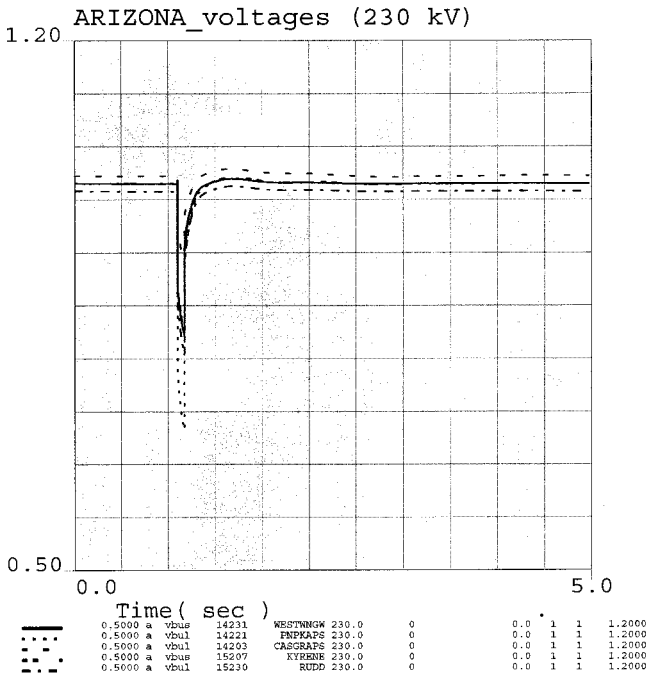

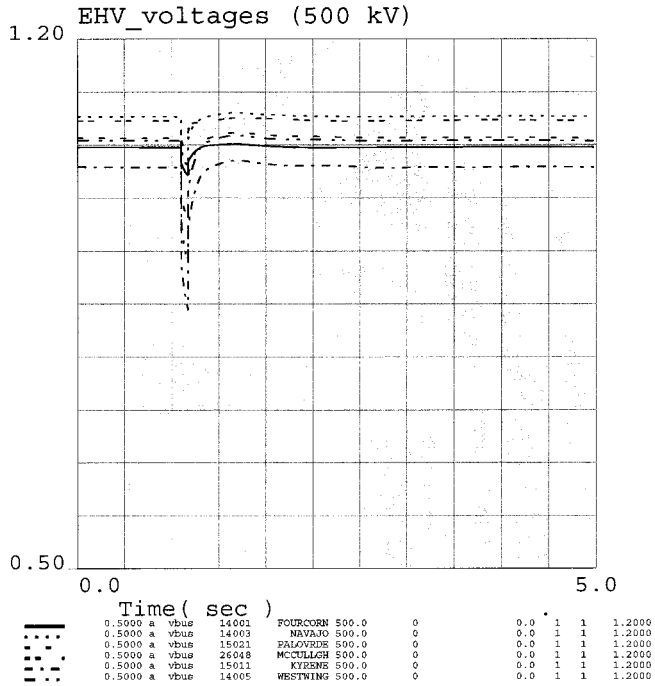

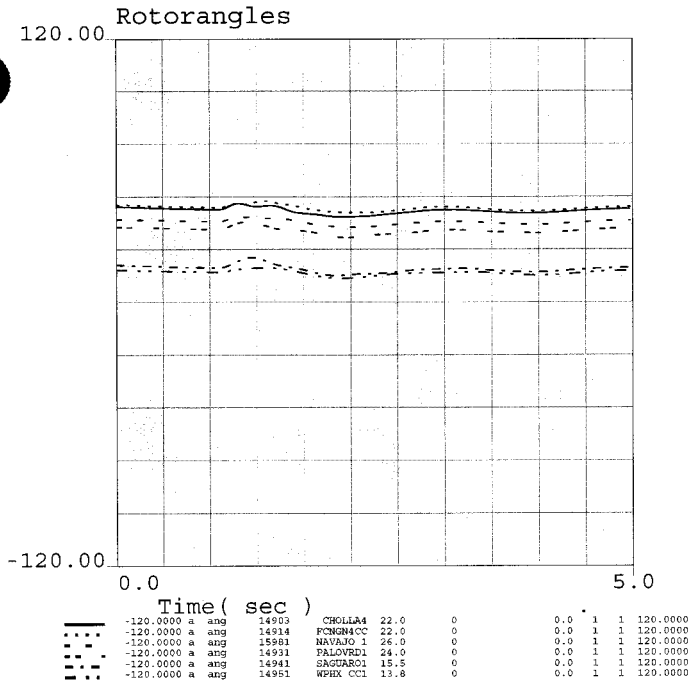

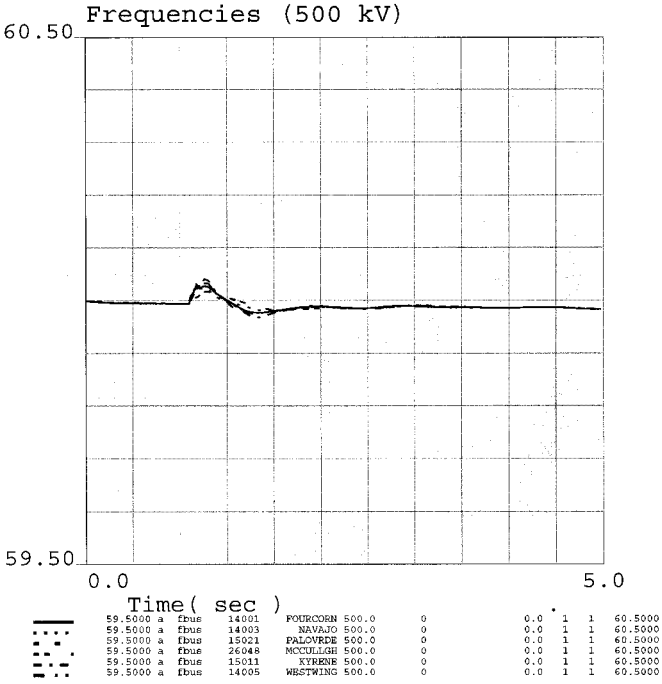

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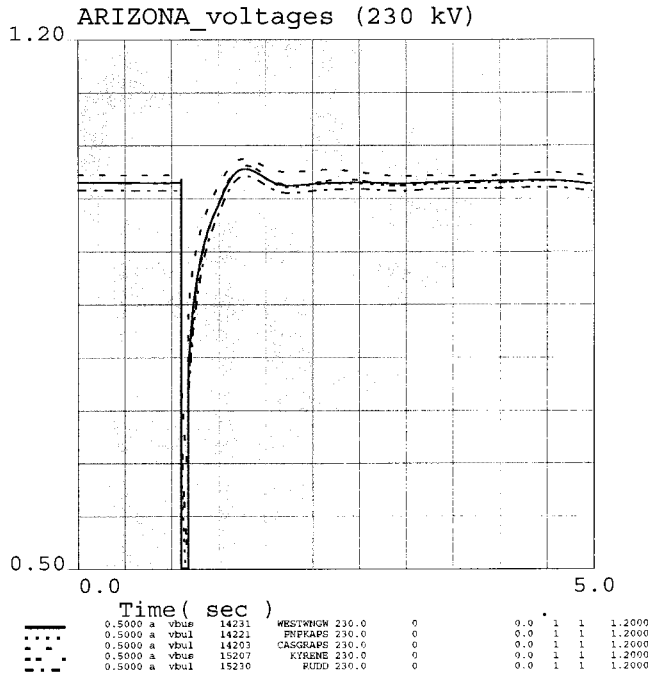

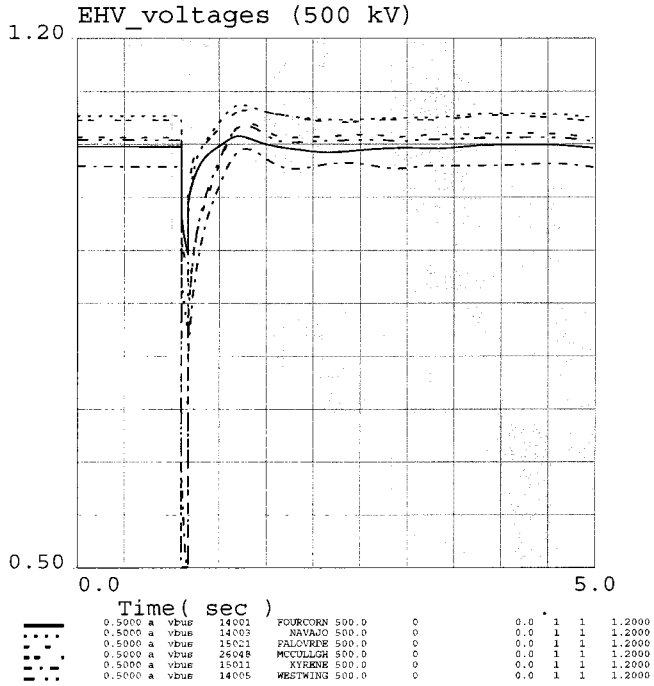

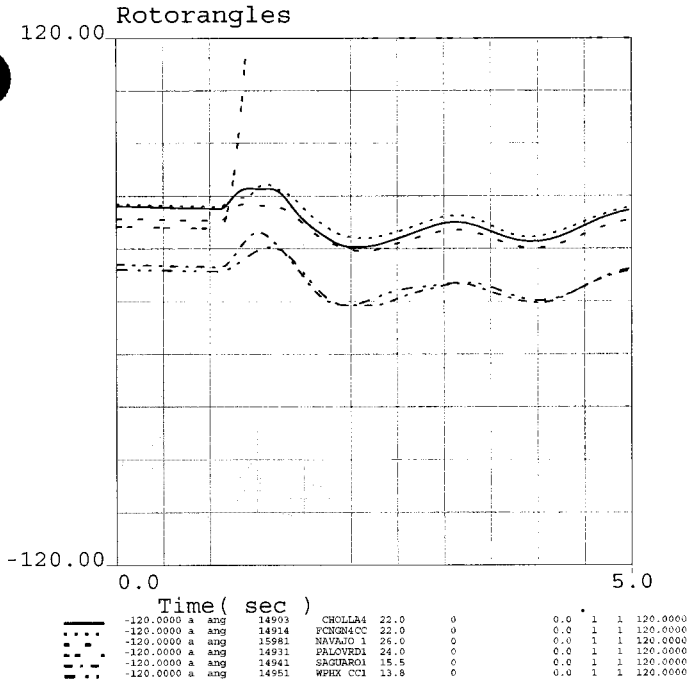

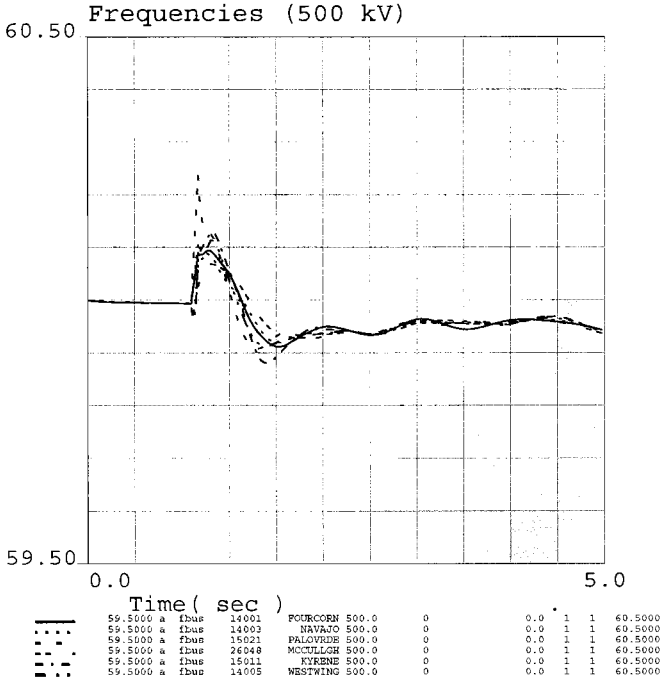

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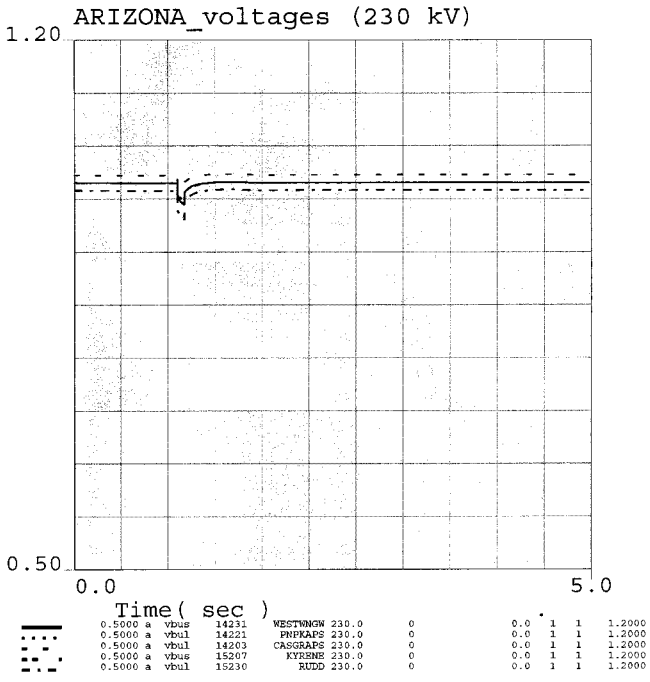

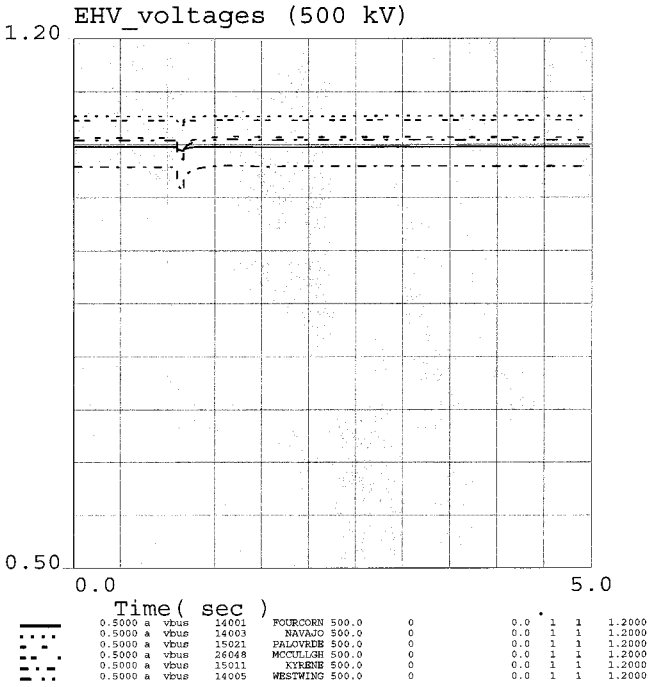

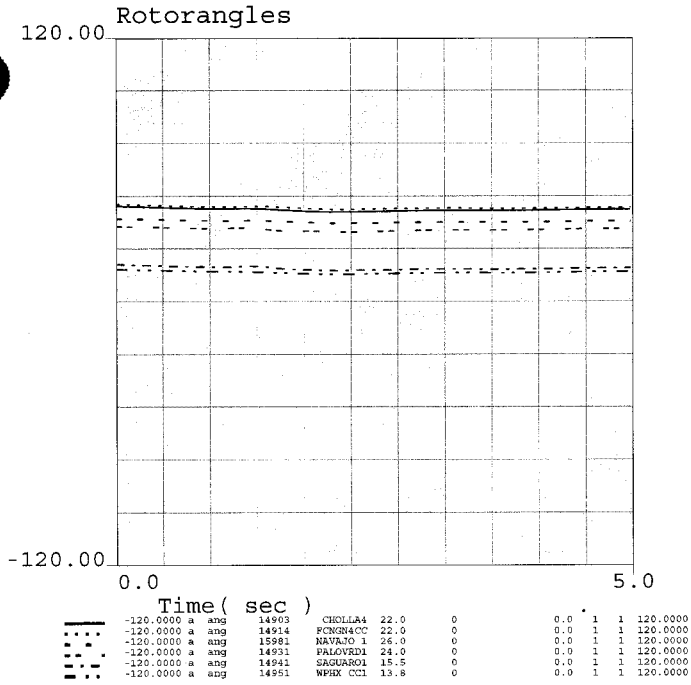

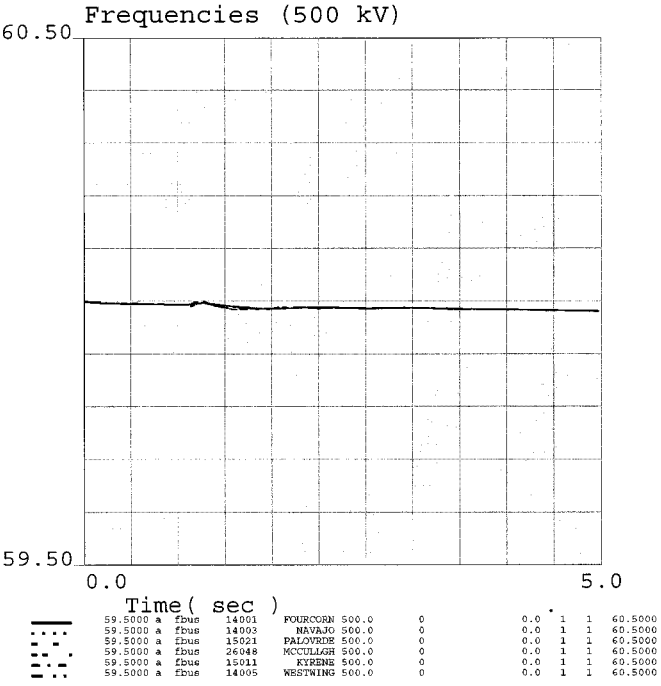

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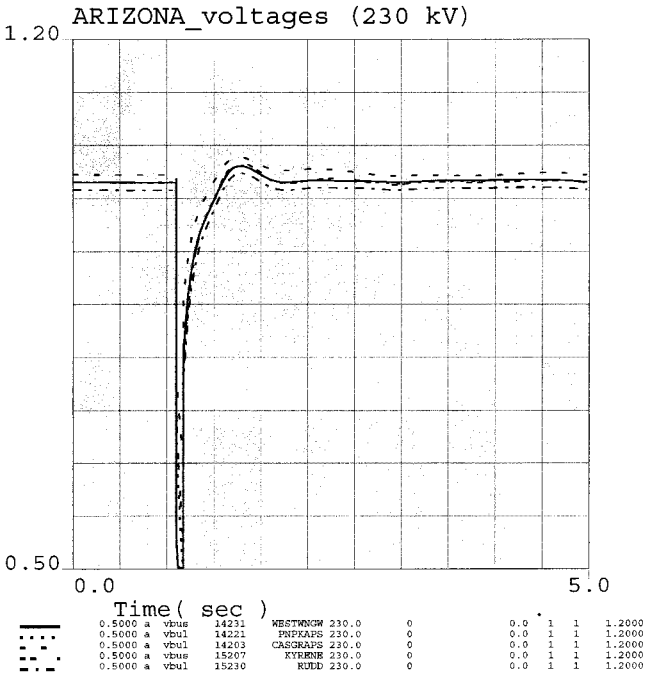

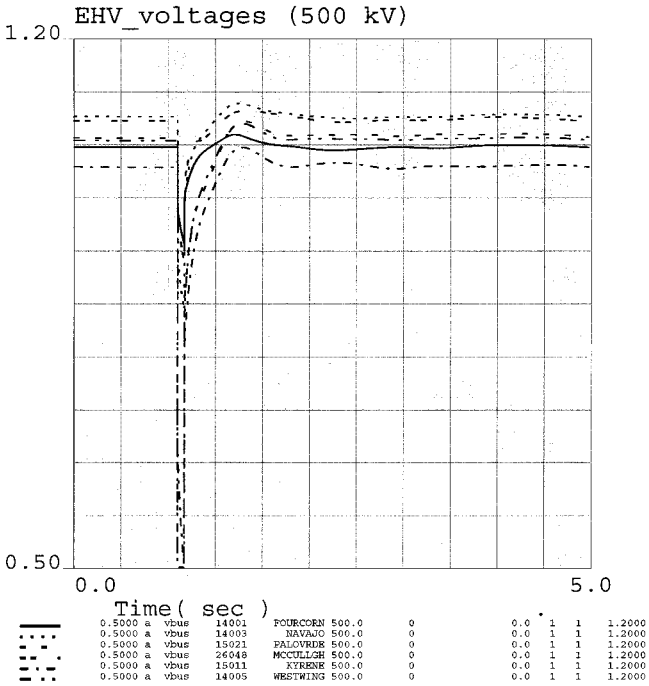

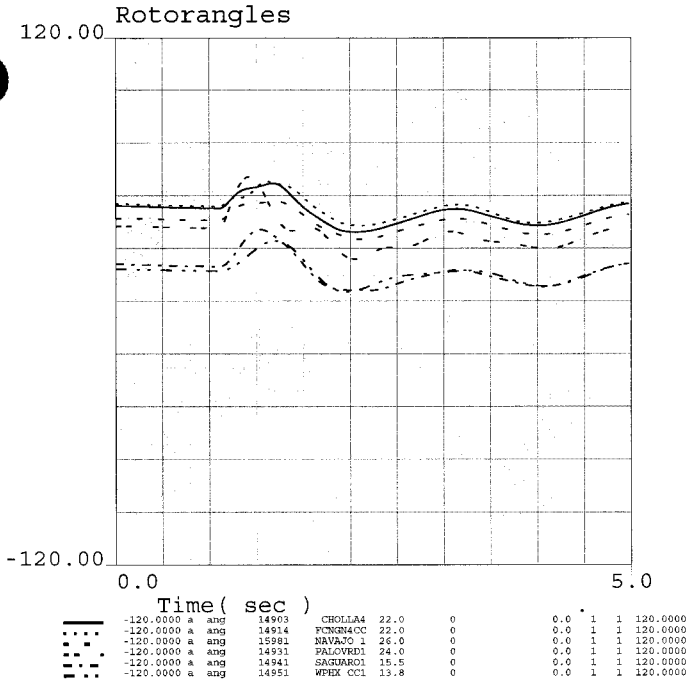

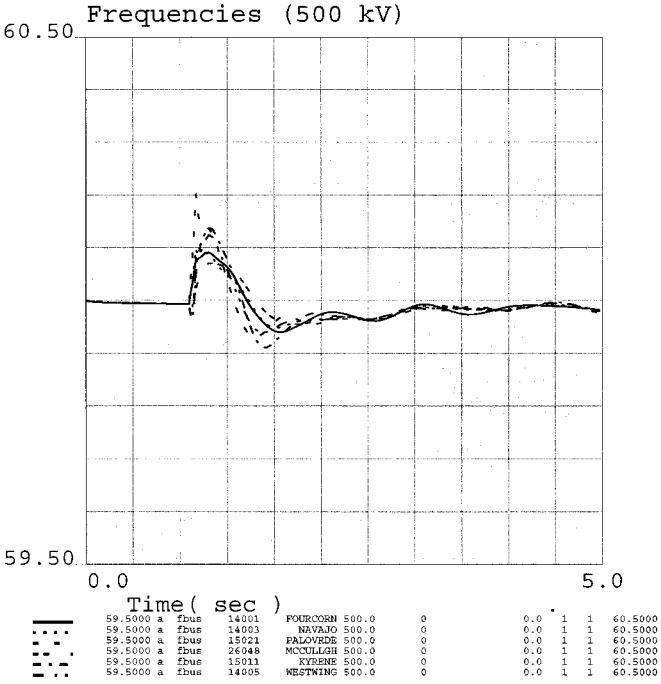

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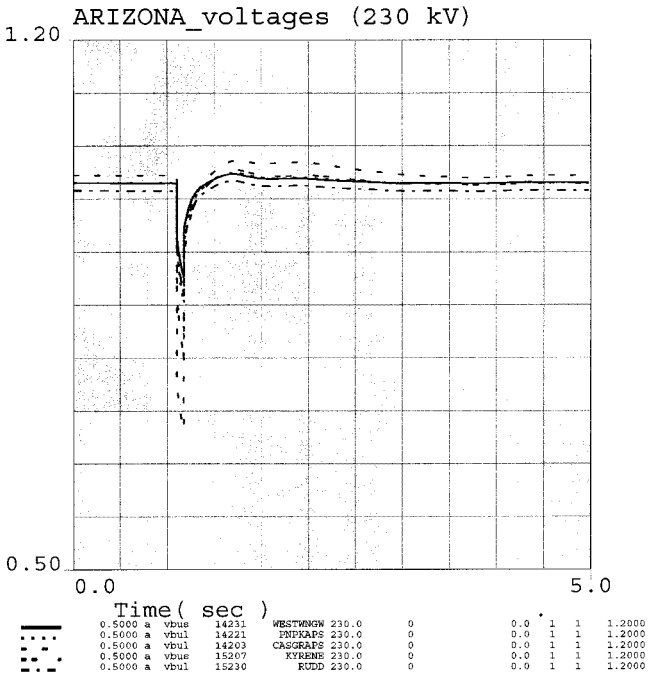

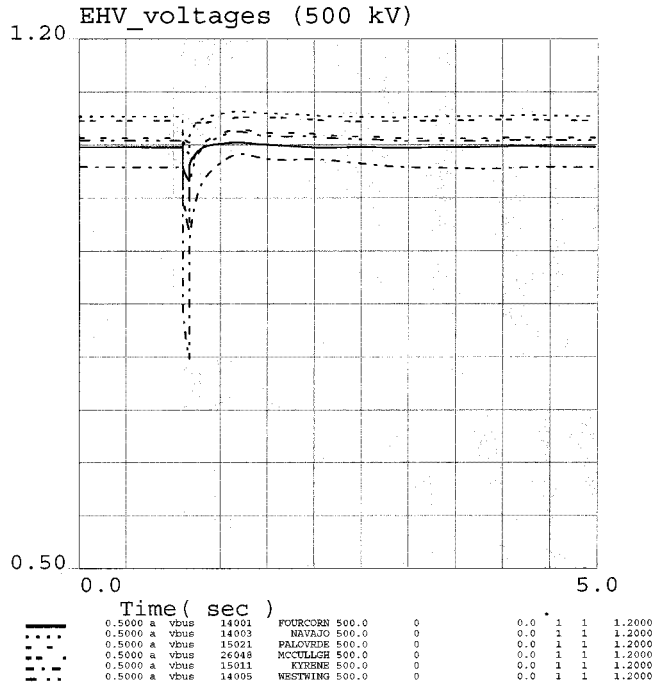

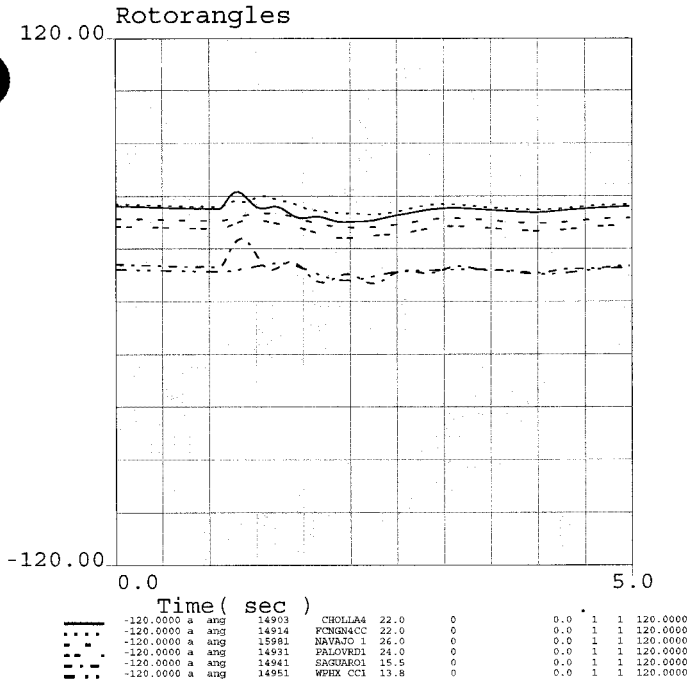

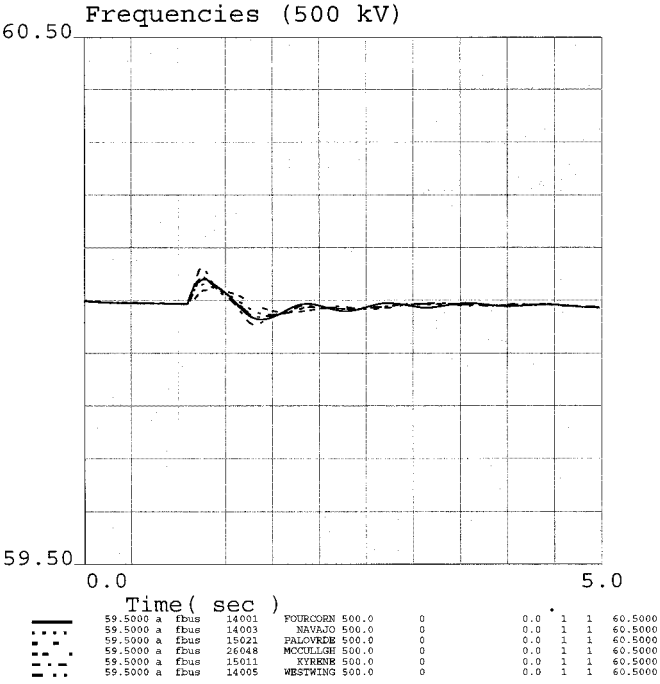

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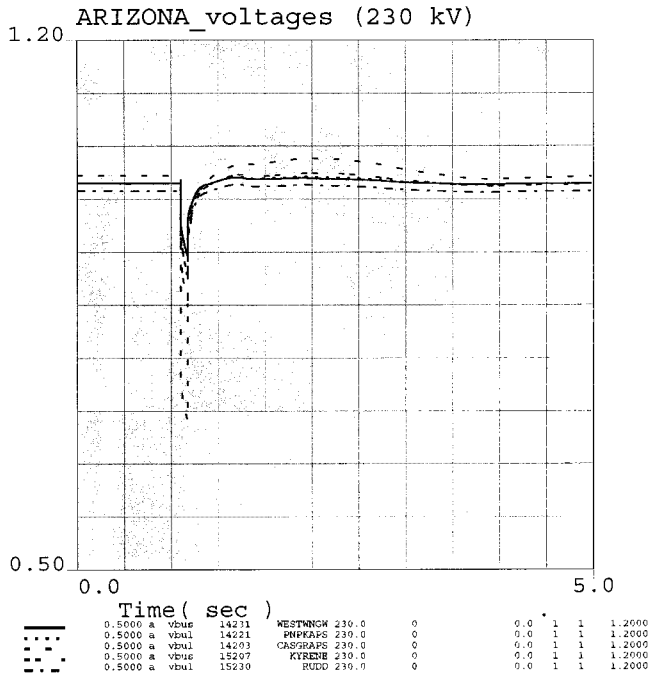

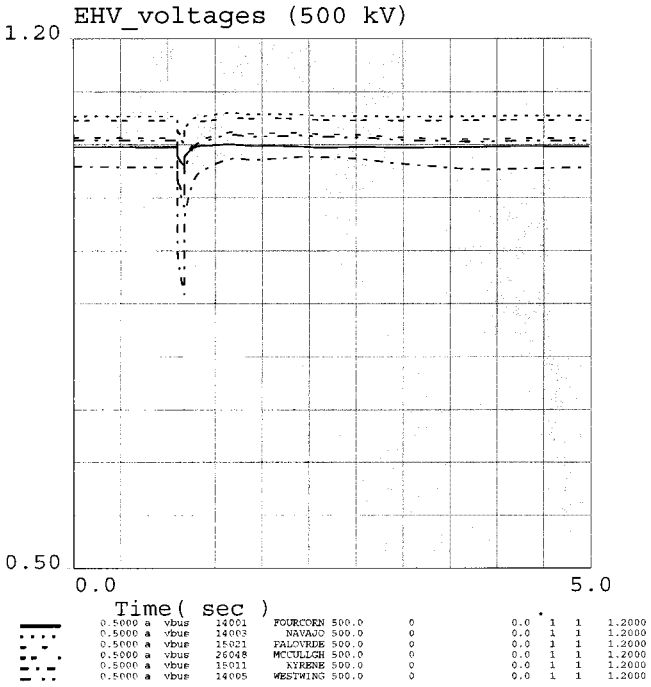

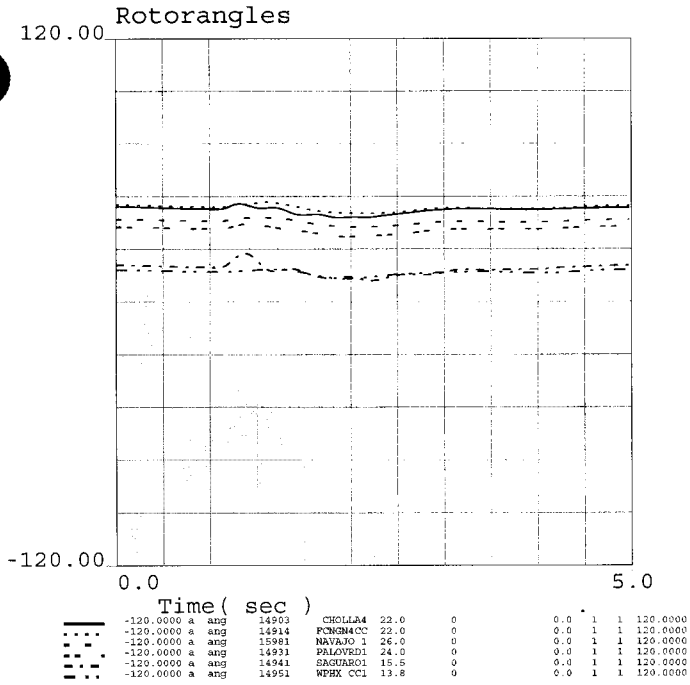

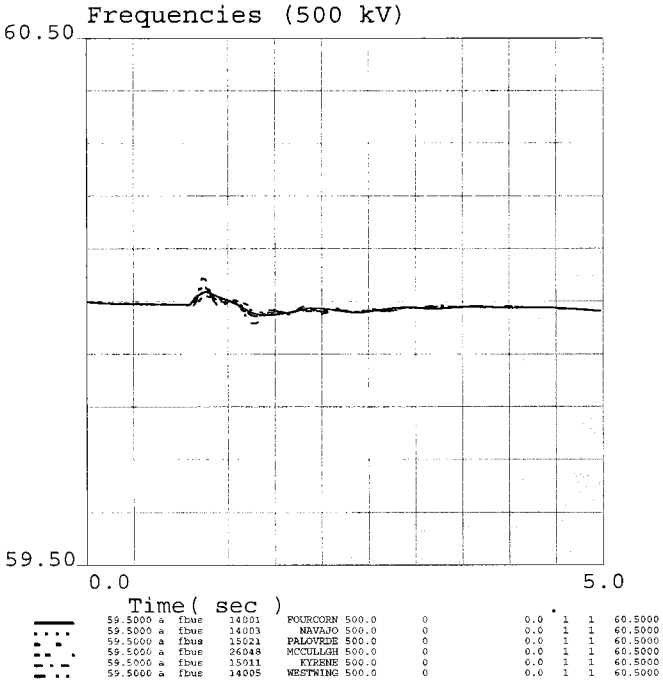

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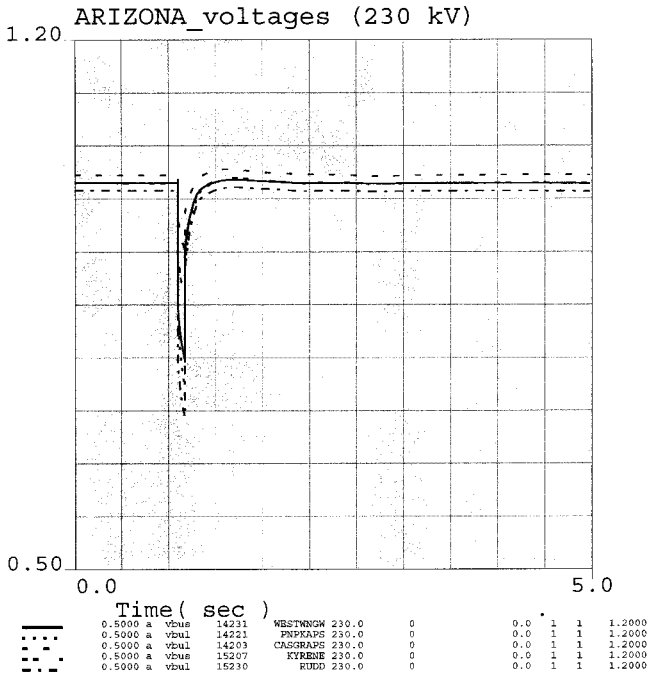

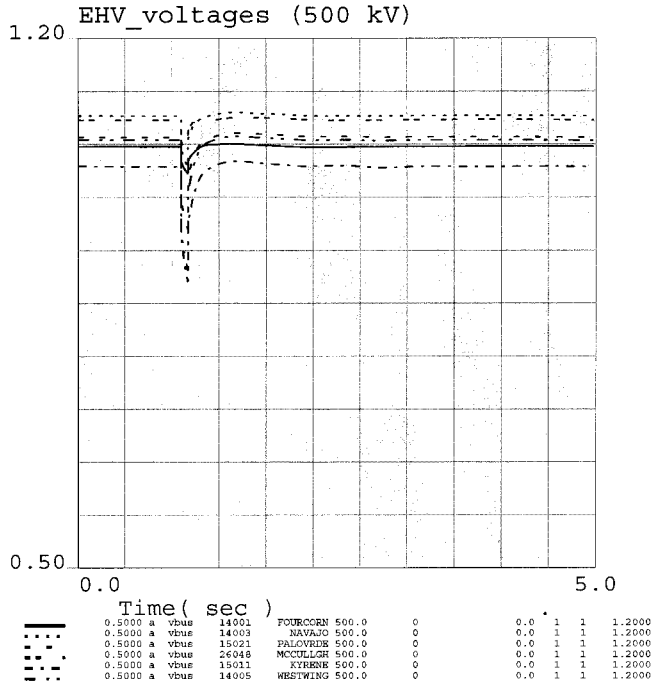

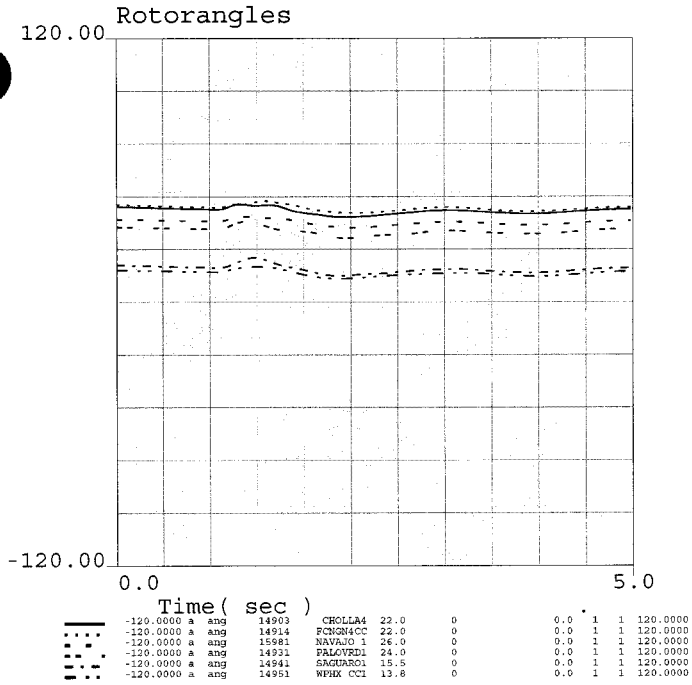

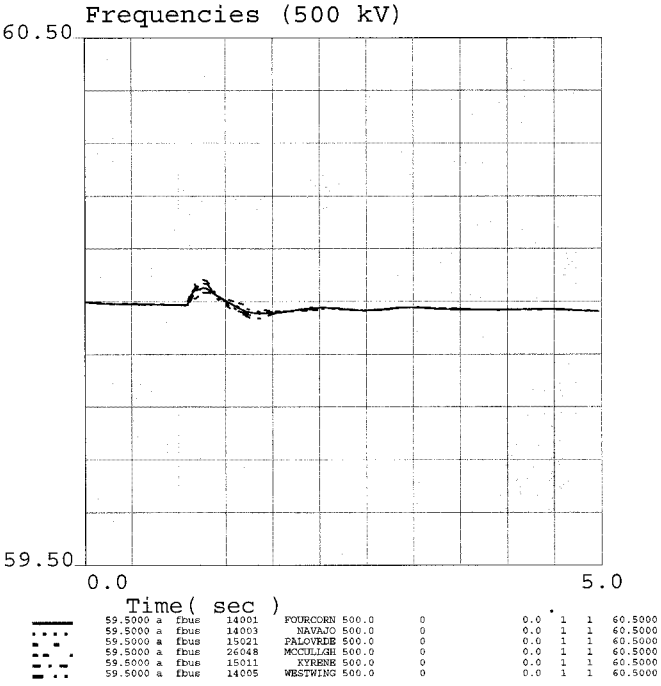

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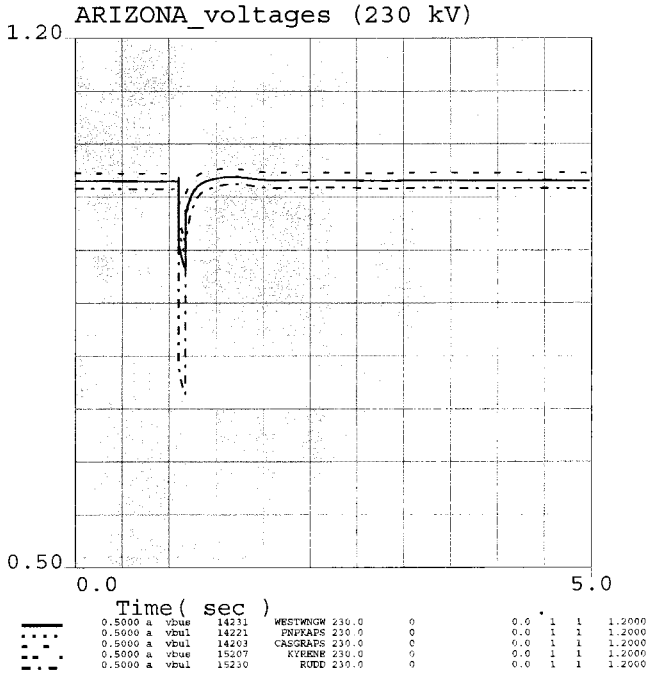

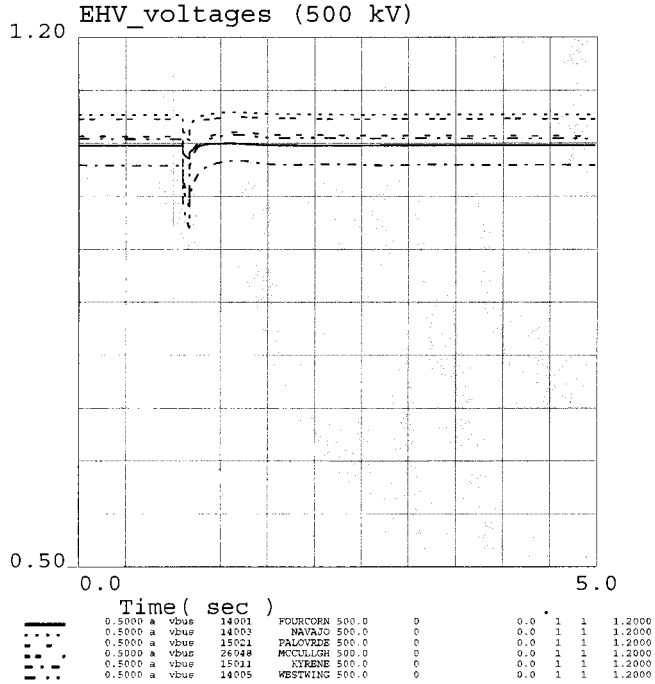

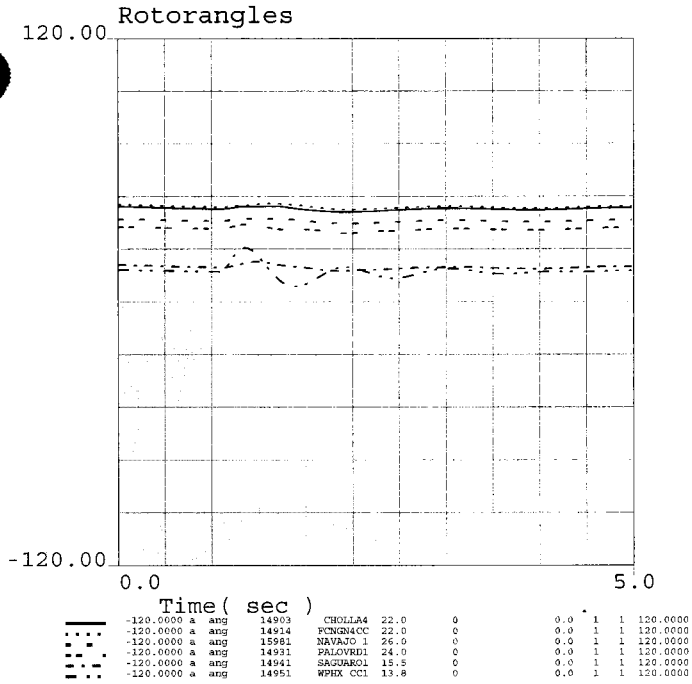

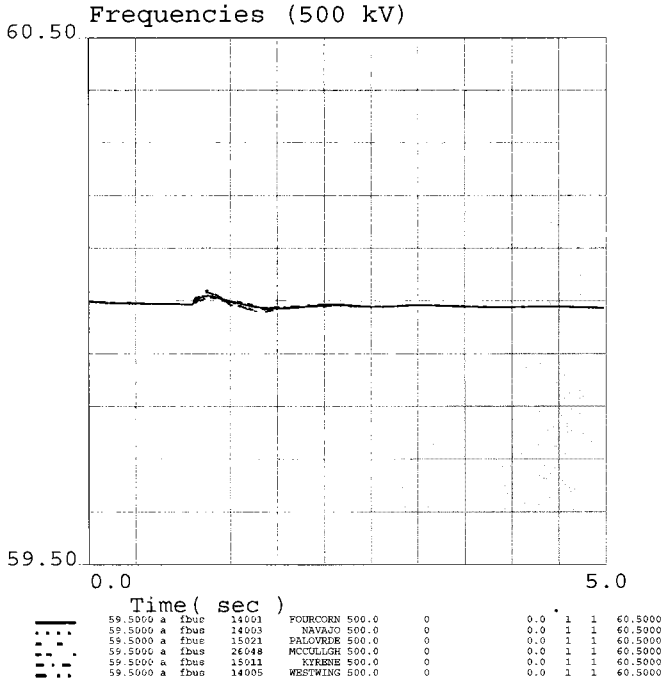

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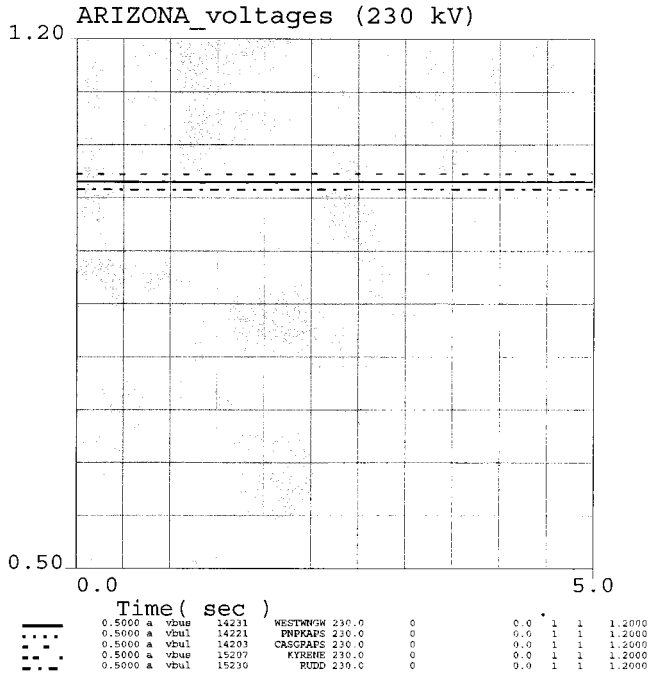

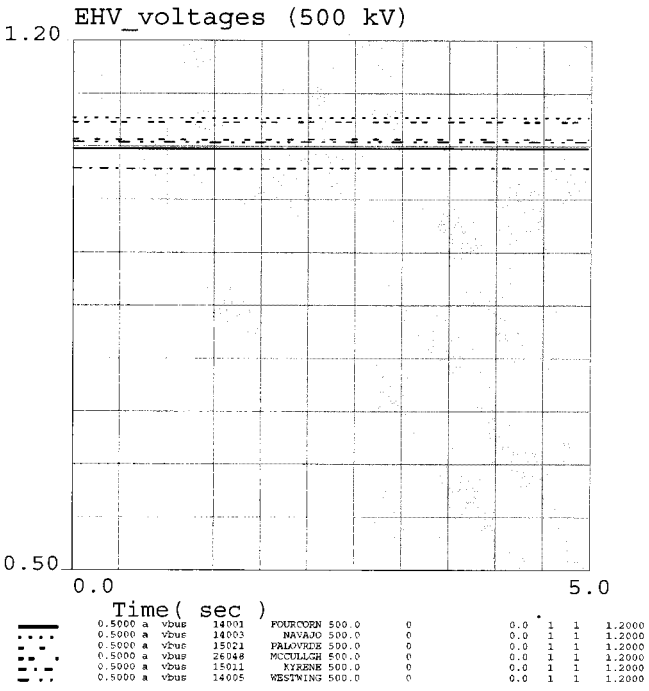

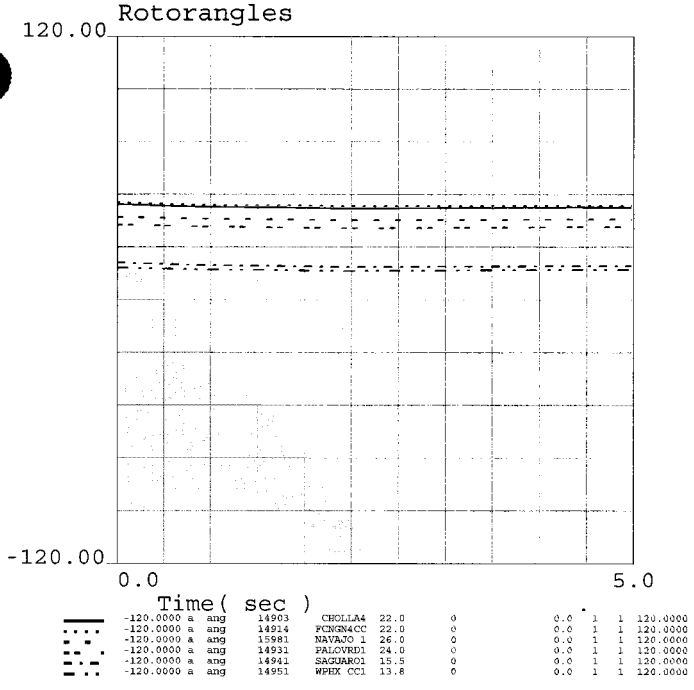

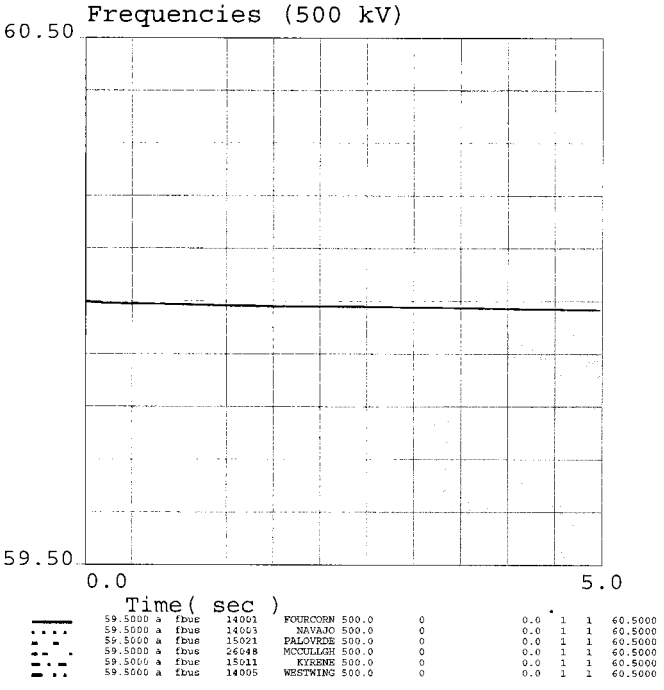

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