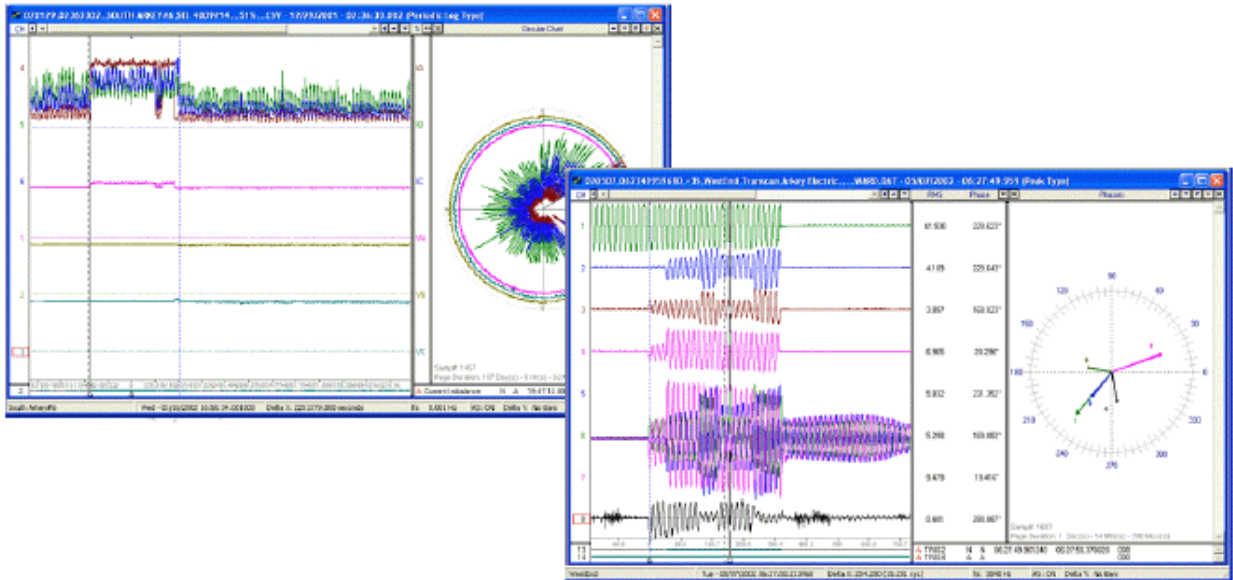


WAVEFORM DATA ANALYSIS EXPERT (WAVEWIN™)

UNIVERSAL PROGRAM FOR INTELLIGENT INTEGRATION
OF MEASUREMENT AND PROTECTION DATA



Product & Services Description Document

Prepared By

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UNIVERSAL PROGRAM FOR INTELLIGENT INTEGRATION OF MEASUREMENT AND PROTECTION DATA

(WAVEWIN™)

PRODUCT & SERVICES DESCRIPTION DOCUMENT, 01/01/2007

I) SUMMARY

Digital protection and measurement devices or “smart devices” such as relays, fault recorders, meters and sensors, generate large volumes of data. On a large power system such devices may generate gigabytes of data every day. Some of that data contains critical performance and reliability data, but the majority of the data does not contain any pertinent information. Considerable time is expended in manually inspecting all of the data trying to determine where the problem is and why it happened.

The main concept is to provide a specialized program that can assist in the process of extracting critical information from the vast wealth of available data. The program is used for fast line restoration, fault and disturbance analysis, dynamic relay testing, real time monitoring of evolving loads, contingency planning and other intelligent maintenance applications.

II) VALUE & KEY FACTORS

The main benefit is increased system reliability. The analysis interfaces are among the best in the world. These interfaces help engineers expose faulty wiring, defective devices, bad configurations, false relay operations, nasty harmonics, unbalanced circuits, overloaded assets and so on. The automated analysis features also provide valuable information such as calibration reports and fault summaries.

Another benefit is reduced engineering time. The program works with various types of proprietary and standard formats and protocols. This eliminates the need for having to learn a diverse mixture of products and individual operating nuances.

Another benefit is minimizing the data loss problem. Legacy devices have small memory buffers and the buffers are frequently overwritten. By continuously polling such devices, the program helps manage the risk of losing valuable data.

The program also provides a powerful filing system that allows for archiving large volumes of waveform data over many years. The filing system is based on the IEEE-PES-PSRC “Naming Convention for Time Sequence Data Files”, and the corresponding sort and query engines can help pick the needle from the haystack in seconds.

The Comtrade maker provides more value. Used to translate actual records of fault occurrences from their native format to the standard IEEE Comtrade format, the program is a key factor in dynamic relay testing where snap shots of actual system disturbances are replayed back into the relays and into modeling and simulation applications. Such applications perform fault location calculations and deduce results about which relays operated and under which conditions (targets).

The calculated channels (or software channels) for automatic processing of raw data also provide additional benefit. A calculated channel can be used to mathematically model an unrecorded or missing phase condition, or to compute sequence components, fault resistance, envelopes and so on. Such modeling provides additional monitoring at no additional cost.

The key factor is universality. The program works through the existing communications infrastructure to communicate with the existing smart devices. The program is open architecture technology with wide operating margins allowing for seamless integration of additional/new devices.

III) SYSTEM DESCRIPTION

The program is Wavewin™ (a registered trademark of SoftStuf, 1991-2007). Wavewin is designed to execute periodically from unmanned computers in the substation and/or from the office (the master stations). The program automatically establishes simultaneous links with multiple smart devices over the various types of available dial-up and network circuits such as RS-232/485 communication processors, telephone switchers, data concentrators, Ethernet networks and so on. Once connected, the program will poll the devices for their latest information. The overall connectivity scheme is shown in Figure-1 of Appendix-A.

The collected information is processed using a formidable array of advanced numerical techniques and the resulting information is saved to a shared folder on the company network called the “repository”. Immediate and secure access to the deposited information is concurrently available to all users on the company network.

The repository files are considered legal records and are always maintained in their original proprietary form. Users on the network can use available software tools to browse the various types of deposited formats or they can use Wavewin to manage and display the formats from a common interface (see Figure-2).

IV) VARIOUS APPLICATIONS

The program is composed of a group of essential applications (tools) that when considered together they provide a complete system for integrating the vast wealth of available and untapped data from today’s smart devices. The user may elect to deploy

the full extent of the provided tools or the user may decide to just use the tools needed to complement their current applications. The main applications of the program are:

1) Comtrade Viewer: Is a high-resolution graphics interface used for display and analysis of digital fault records (see Figure-4) that are formatted following the standard IEEE-PES-PSRC Comtrade format. Established in 1991, Comtrade has been gaining popularity among users and manufacturers alike. Today, Comtrade is the premier format for exchanging digital fault records. The format has too many known derivatives in circulation and Wavewin is recognized worldwide as “works with all derivatives”.

2) Universal Viewer: Is an expanded version of the Comtrade viewer that allows for display and analysis of many other types of standard and proprietary formats for transient and time sequence data (see Figure-6). The standard CSV format is also supported which allows for trending of periodic load measurements over long periods of time (as shown in Figure-5).

The viewer is loaded with advanced analysis features for showing fault and disturbance plots, phasor diagrams, event sequences, harmonics, historic trends, peaks, averages, envelopes, circular charts and more. And, the “Save As” options allows for converting proprietary files to Comtrade files and for creating data files that are inputs to short circuit simulation and modeling applications.

3) Waveform Manager: Is a file manager that is similar to Explorer except that it is specialized in dealing with files from smart devices. These devices produce large numbers of files that have complex inter relationships and varying naming conventions (many events can be in one file, or one event can be in multiple files).

The file manager uses an inference mechanism that inspects the filenames and automatically determines the dates and times of event occurrences and the type of originating equipment. All of the provided functions (sort, query, copy, move, delete, edit, append and merge) operate based on the results of the inference engine (as shown in Figure-2).

The manager supports the format specified in the IEEE-PES-PSRC report “File Naming Convention for Time Sequence Data”. The user can select any group of files having various types of proprietary naming schemes and automatically rename them to the IEEE naming convention.

4) Device Manager: Is the automatic data collection application. The manager has an extensive library of communication protocols for communicating with various types of smart devices and master stations and is specialized in the extraction of the latest fault information and in the processing of periodic load measurements.

Any critical information captured is automatically transferred upon detection to the repository as shown in Figure-3 (report by exception). The manager provides daily reports on modem and communication integrity, and for security purposes is capable of

automatically changing the passwords on the smart devices (random password management) upon request from the user.

5) Station Monitor: Is an expert system application that organizes the collected and/or calculated information based on circuit and station name and provides a host of intelligent maintenance applications. The monitor can be configured to automatically apply a list of knowledge rules for tracking of evolving load conditions and for detection of imbalanced circuits, overloaded assets, efficiency problems, broken equipment, leaking cabinets and so on.

The monitor shows single line diagrams for the integrated stations and populates these diagrams with the results from the latest scans by the device manager (as seen in Figure-7). With a simple double click the user can view a complete load history from any device or station in one screen and analyze for trends.

V) VARIOUS TYPES OF INFORMATION

Examples of waveform data include:

- Oscillography Data (analog & digital traces, angles, magnitudes, harmonics, status)
- Periodic Load Data (amps, volts, watts, vars, power factor)
- Digital Sensory Data (temperature, humidity, motion, saturation, trip indication)

Examples of critical reliability information include:

- Fault Summaries (type, location, duration, magnitude, targets, settings)
- Event Sequences (alarms, triggers, breaker operations)
- Planning Reports (totals in/out, peaks, imbalances, overloads, efficiencies)
- Maintenance Reports (water leaks, heating elements, oil filtration, relative saturation)
- Integrity Checks (connections, communications, storage)

VI) VARIOUS CONFIGURATIONS

Where available, smart devices with existing dial-up connections are polled periodically from the master station for their latest information (poll daily and/or upon demand).

Where available, smart devices with existing network connections (real, native or virtual ports) are polled continuously for their latest information (real time all the time).

Where available, smart devices with existing data collection systems (master stations) are not polled directly but are integrated by polling their master stations.

If remote connections (such as modems, switches, data concentrators and networks) to the smart devices are not available then future plans to deploy the latest in remote

communications technology without having to change or affect the devices will be defined and formally proposed. A typical network diagram for a substation data concentrator (SDC) with multiple Ethernet to serial RS232/485 connections is shown in Figure-8.

If remote connections are not possible as in the electro-mechanical equipment case then future plans to retrofit the equipment with digital sensors for trip indication and other measurements will be defined and formally proposed.

Where available, smart devices that are known (communication protocols and data formats already supported) are seamlessly integrated (plug & play). If the devices are not known then plans to acquire and support their protocols and formats will be defined and formally proposed as described in the next section.

VII) DRIVERS & DEVICES

SoftStuf will initially provide an extensive library of drivers for working with various types of smart devices and remote access connections including but not limited to:

- SEL (all relays and communication processors)
- GE (DLP, ALPS and LPS relays)
- ABB (MDAR, 301, 302, DPU, TPU & GPU relays)
- RFL (9300 relays, 9780 and 9785 SOE Modules and 9660 processors)
- DRANTZ-BMI (SER)
- Satec (all meters)
- Bitronics (PowerServe meters and Multicom)
- Alstom (OPTIMHO LFZP)
- FLUKE (Scope meters)
- Hathaway (DFR I, II, IIB and 2000)
- Mehta (Transcan DFR)
- EMAX (Faxtrax & Director DFR)
- Rochester (TR16** DFR)
- NxtPhase (Tesla DFR)
- Advanced Power Technologies (TTC-1000 Ambient Temperature Probe)
- Syprotec (Hydran Transformer Monitor)
- Vaisala (HMP Moisture Transmitter)
- Domino (HMP PPM Transmitter)
- Weschler Instrument (Transformer Advantage CT)
- Westronics Inc. (Digital Recorder)
- Intelligent Control, Inc. (INCON Tap Position Sensor)
- Arbiter (GPS Clock)
- True-Time (GPS Clock)
- Pulsar (Focus Modules)
- Cutler & Hammer (PMCOM)

- DAQ (RTU & SES92)
- Control (Rocket Ports, VS1000, RTS, and ATS communication processors)

In the event that any additional drivers and features are requested then SoftStuf will develop such drivers and features and bill at rates that are mutually agreed upon.

VIII) TERMS

SoftStuf is the supplier of the Wavewin program and support services (including training). For the duration of any deployment project, the specified SoftStuf personnel will be authorized to access and work with the specified types of smart devices, their manuals, formats or any other documentation that is related to the project scope.

SoftStuf will provide a qualified development and technical support team. The team will answer questions about operating the program and will provide training, installation instructions, quick start manuals, technical drawings, and/or any other type of documentation that is essential for the operation of the program.

IX) UPGRADES & DELIVERABLES

Upgrades are developed frequently and are made available electronically via a protected web site. The frequency of upgrades is about once per quarter.

The deliverables will include the license to use the program along with copies of the executable and the manuals. In the event that custom upgrades are requested then such development will be based on a mutual price and time frame that is agreeable with the natural evolution of the program.

X) SOFTWARE REQUIREMENTS

Wavewin is a compact application that requires minimal installation and support. The requirements for the program are:

- Windows 98, 2000, XP, NT, or Embedded XP and NT systems, or Linux
- 16 Mbytes of available hard-disk space
- 256 Mbytes of available RAM
- Read/Write access to local drives and shared drives on the company network

The program does not modify any system files. It can be launched from standalone PCs or directly from the company network. The program is typically installed on a shared network drive where multiple users can execute concurrently from their own PCs. If network bandwidth is minimal, then the program can be directly installed on the

individual PCs. An unlimited number of users can use it provided that the proper read/write access levels are assigned to each user.

On the other hand, the memory and throughput requirements for the repository vary depending on the type and number of devices integrated. A typical record from a digital relay may be up to 100 Kilobytes in size while a record from a digital fault recorder may be up to 5 Megabytes in size. For an integrated array of approximately 500 digital relays and fault recorders expect a few hundred Gigabytes of data each year.

As for throughput, smart devices have low data transfer rates (around 19,200 bps). With 4 modems used, the maximum data transfer rate to the Master Station is about 80 Kbps but only for a few hours each day. The program is designed to handle up to 2.56 Mbps continuous. The availability is extremely high, the program has automatic archive and upgrade engines and supports watchdog timers and remote boot switches.

XI) WARRANTIES

SoftStuf warrants that it has all legal rights, ownership, title and interest in the Wavewin program and documentation. The program is copyright protected and is a registered trademark of SoftStuf, Inc. (1991-2007).

SoftStuf also warrants that the provided program will substantially achieve the functionality described in this document. In the event that any future deficiency is discovered in the program and if notice is given to SoftStuf of such deficiency then SoftStuf shall at its own sole expense make changes necessary to correct said deficiency within a reasonable time of being so notified.

XII) ADDITIONAL INFORMATION

For additional information please visit www.softstuf.com, or contact:

Amir Makki
215-922-6880 (phone)
800-818-3463 (work)
amir@softstuf.com

Appendix (A) Diagrams & Figures

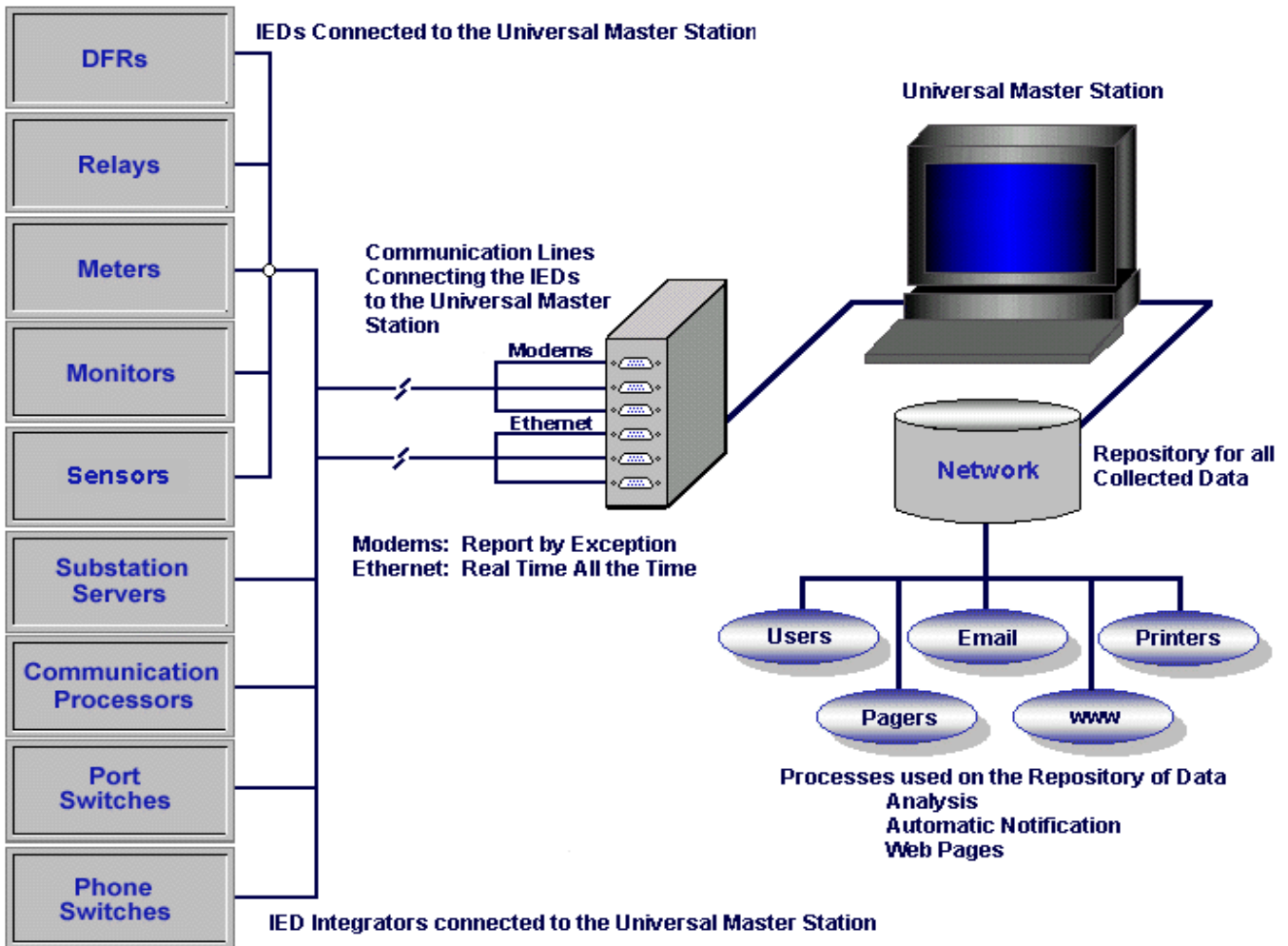
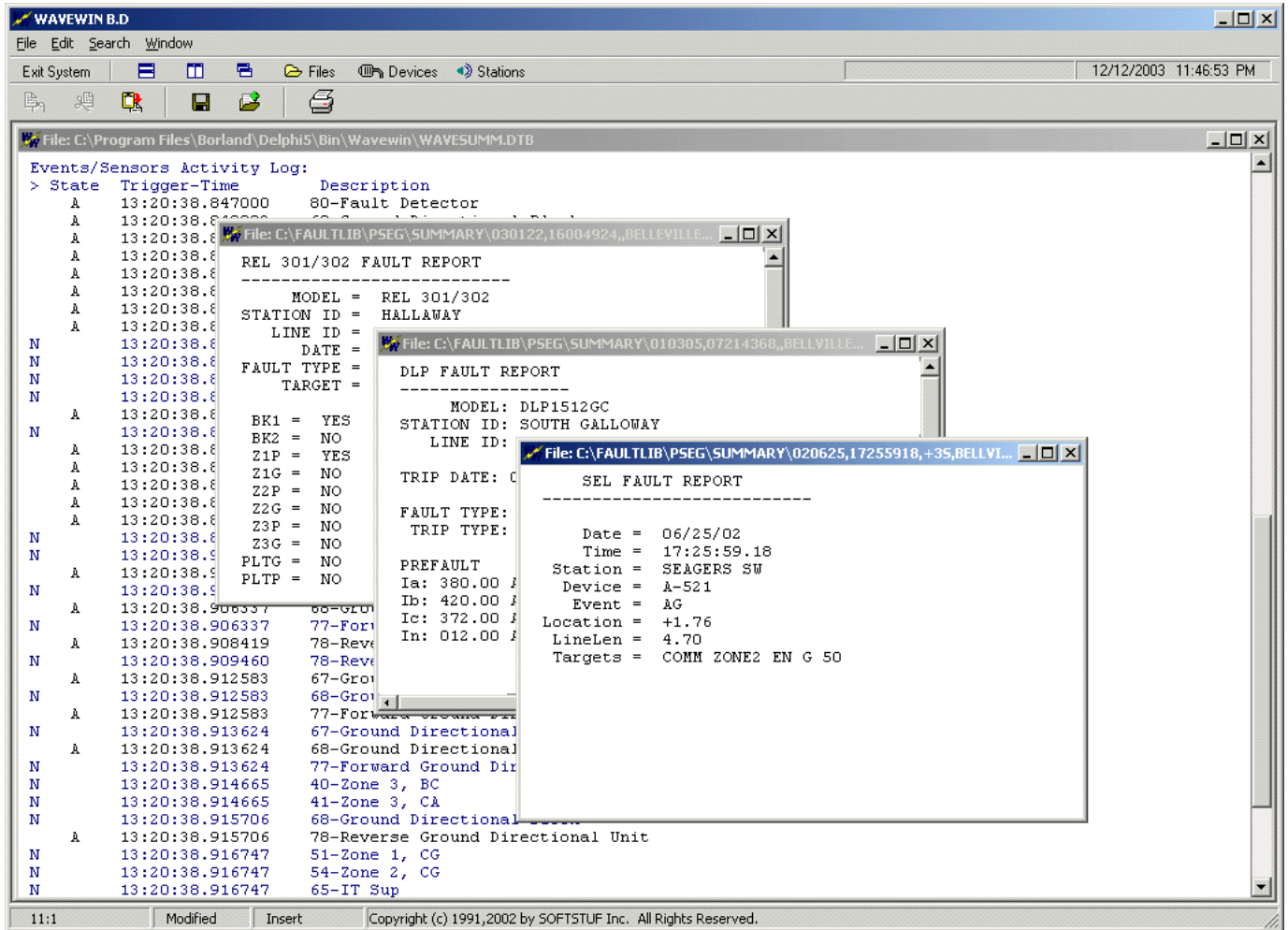


Figure-1, Communications & Access Infrastructure

WAVEWIN 9.L										
Files Sort Mark Options Drivers Query Window Help										
Exit System										
C:\FAULTLIB\LONGFILES										
Substation	Device	Fault Date	Fault Time	Save Date	Save Time	Driver	File Name	F-Type	Size	TCod
				12 / 16 / 2000	22 : 47 : 50	Root Dir	.	.	0	
				12 / 16 / 2000	22 : 47 : 50	Previous Dir	.	.	0	
RAHWAY (0004)	SEL-R200 (003)	09 / 01 / 2000	20 : 14 : 42 . 000	09 / 18 / 2000	11 : 16 : 42	SEL-Short	000901.201442...	SEL	6070	-4D
RAHWAY (0004)	SEL-R200 (003)	09 / 01 / 2000	20 : 14 : 40 . 090	10 / 06 / 2000	10 : 53 : 58	SEL-Short	000901.201440...	SEL	6070	-4D
RAHWAY (0004)	SEL-R200 (003)	04 / 04 / 2000	00 : 22 : 57 . 050	09 / 18 / 2000	11 : 18 : 02	SEL-Short	000404.002257...	SEL	4642	-4D
RAHWAY (0004)	SEL-R200 (003)	04 / 04 / 2000	00 : 21 : 33 . 040	09 / 18 / 2000	11 : 18 : 36	SEL-Short	000404.002133...	SEL	4642	-4D
BERGEN SWITCH	REL 301	05 / 08 / 2000	14 : 42 : 40 . 332	10 / 06 / 2000	10 : 56 : 44	REL 300/301/302	000508.144240...	REL	5449	-4S
ESSEX SUBSTATION	ABB 501 REL	05 / 08 / 2000	12 : 34 : 56 . 789	04 / 24 / 1998	16 : 55 : 40	Comtrade	000508.123456...	DAT	158401	-5S
ESSEX SUBSTATION	ABB 501 REL	05 / 08 / 2000	12 : 34 : 56 . 789	04 / 24 / 1998	16 : 54 : 36	ASCII	000508.123456...	CFG	1157	-5S
RAHWAY (0004)	SEL-T477 (002)	04 / 04 / 2000	00 : 21 : 29 . 080	09 / 18 / 2000	11 : 16 : 30	SEL-Short	000404.002129...	SEL	4627	-4D
SEWAREN SWITCH	SEL 321	12 / 20 / 1999	09 : 43 : 56 . 000	12 / 20 / 1999	09 : 43 : 56	ASCII	991220.094356...	DTB	2083976	-4S
RAHWAY (0004)	SEL-R200 (003)	11 / 08 / 1999	10 : 04 : 39 . 090	09 / 18 / 2000	11 : 15 : 58	ASCII	991108.100439...	SLH	2348	-4D
ALLENTOWN	B80-GPU2000	10 / 27 / 1999	09 : 11 : 07 . 287	10 / 27 / 1999	09 : 11 : 16	Comtrade	991027.091107...	DAT	414720	-5S
ALLENTOWN	B80-GPU2000	10 / 27 / 1999	09 : 11 : 07 . 287	10 / 27 / 1999	09 : 11 : 16	ASCII	991027.091107...	CFG	1858	-5S
HENRY SWITCH	DFRIIB	07 / 22 / 1999	17 : 22 : 06 . 181	07 / 22 / 1999	17 : 22 : 06	Comtrade	990722.172206...	DAT	557056	-5S
HENRY SWITCH	DFRIIB	07 / 22 / 1999	17 : 22 : 06 . 181	07 / 22 / 1999	17 : 22 : 06	ASCII	990722.172206...	CFG	6781	-5S
RAHWAY (0004)	SEL-T477 (002)	06 / 30 / 1999				SEL-Short	990630.043016...	SEL	4627	-4D
RAHWAY (0004)	SEL-T477 (002)	06 / 30 / 1999				SEL-Short	990630.043016...	SEL	4975	-4D
GRIFFIN BETA	POWER SERVE	04 / 29 / 1999				Comtrade	990429.180926...	DAT	506227	-4S
GRIFFIN BETA	POWER SERVE	04 / 29 / 1999				ASCII	990429.180926...	CFG	1359	-4S
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091320...	SEL	4642	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091231...	SEL	4642	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091228...	SEL	4644	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091228...	SEL	4990	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091135...	SEL	4644	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091134...	SEL	4643	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				SEL-Short	990326.091131...	SEL	4643	-4D
RAHWAY (0004)	SEL-U567 (004)	03 / 26 / 1999				ASCII	990326.091131...	SLH	2194	-4D
RAHWAY (0004)	SEL-T477 (002)	03 / 24 / 1999				SEL-Short	990324.125440...	SEL	4630	-4D
RAHWAY (0004)	SEL-T477 (002)	03 / 24 / 1999				SEL-Short	990324.125438...	SEL	4976	-4D
RAHWAY (0004)	SEL-T477 (002)	03 / 24 / 1999				ASCII	990324.125438...	SLH	2194	-4D
RAHWAY (0004)	SEL-T592 (001)	03 / 23 / 1999				ASCII	990323.091922...	SLH	2348	-4D
BRANCHBURG 500KV	DFRIIB	06 / 12 / 1997				Comtrade	970612.121311...	DAT	88590	-5S
BRANCHBURG 500KV	DFRIIB	06 / 12 / 1997				ASCII	970612.121311...	CFG	588	-5S
MANWEBF	K13-GEC-RELAY	11 / 21 / 1996				Comtrade	961121.114122...	DAT	66431	-2E
MANWEBF	K13-GEC-RELAY	11 / 21 / 1996				ASCII	961121.114122...	CFG	922	-2E
NILES SUBSTATION	DLP RELAY	06 / 09 / 1996				Comtrade	960609.003738...	DAT	107834	-4S
NILES SUBSTATION	DLP RELAY	06 / 09 / 1996	00 : 37 : 38 . 181	06 / 09 / 1996	00 : 37 : 38	ASCII	960609.003738...	CFG	2369	-4S
RAH*	SEL-R2*	1 / / 2000	:	/ /	:					

Figure–2, Repository Information Browser and Historian



Figure–3, Fault Location Reports & Event Sequences

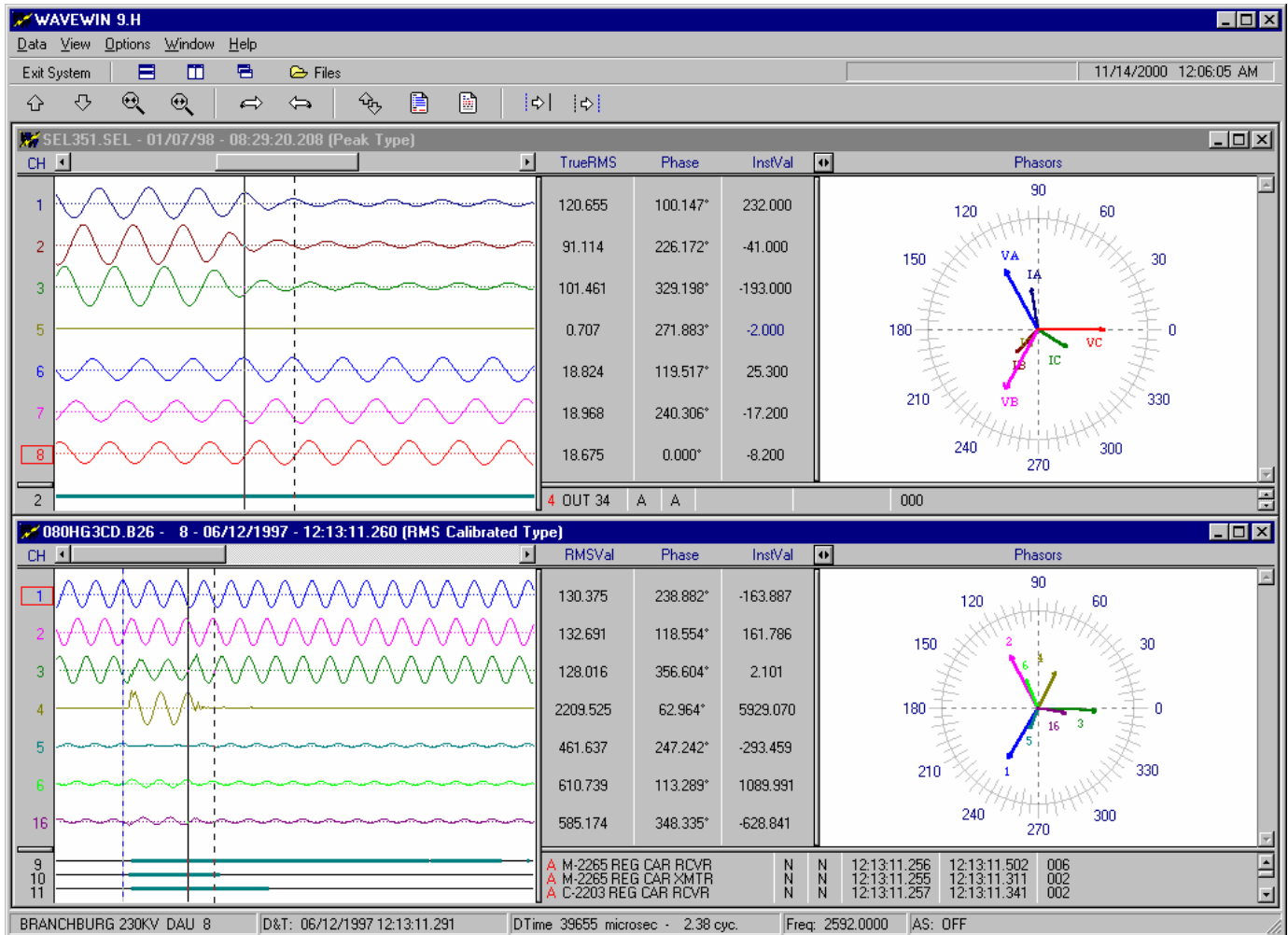


Figure-4, Advanced Transient & Disturbance Data Analysis

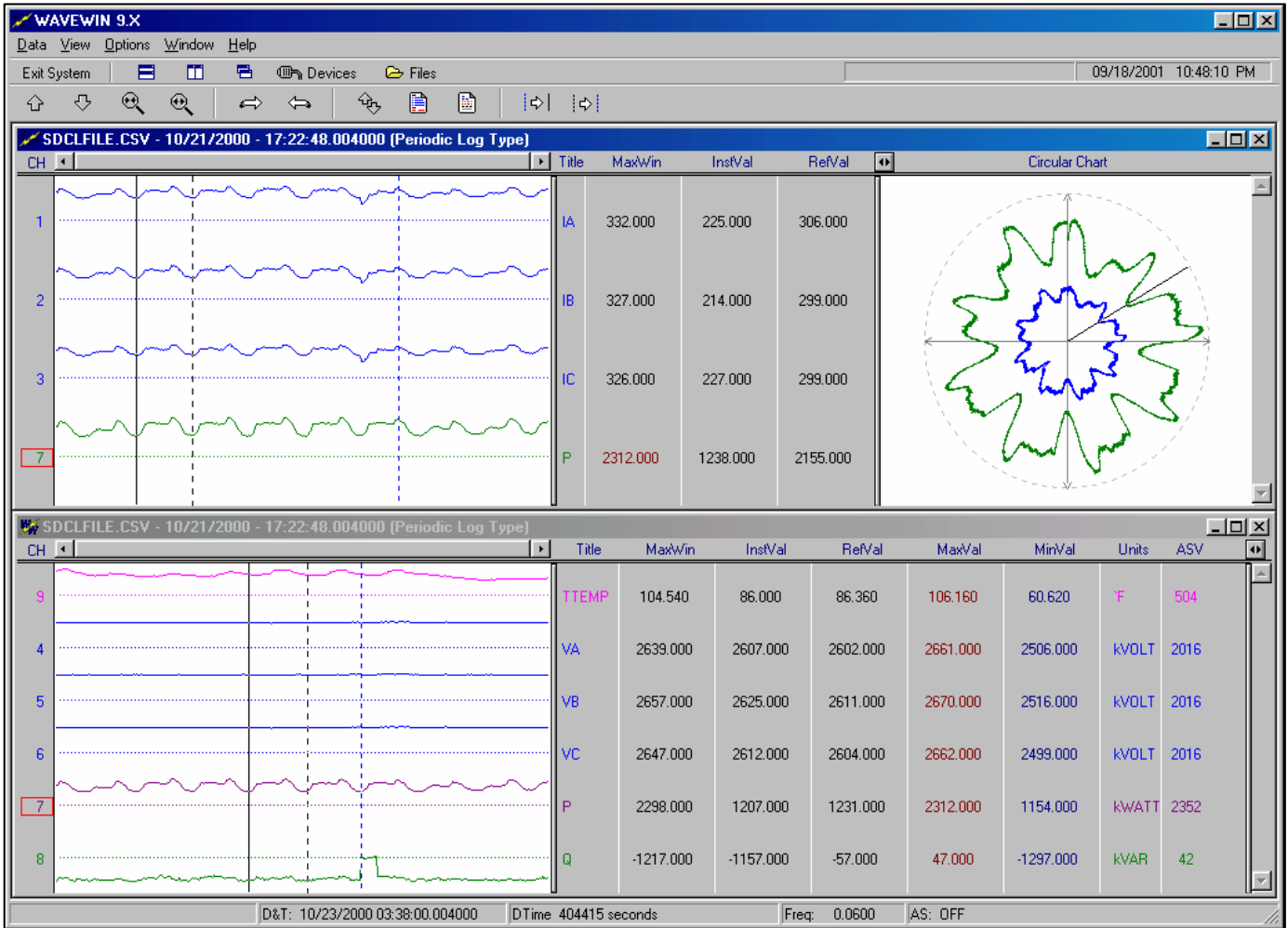


Figure-5, Periodic Load Logs & Trend Analysis

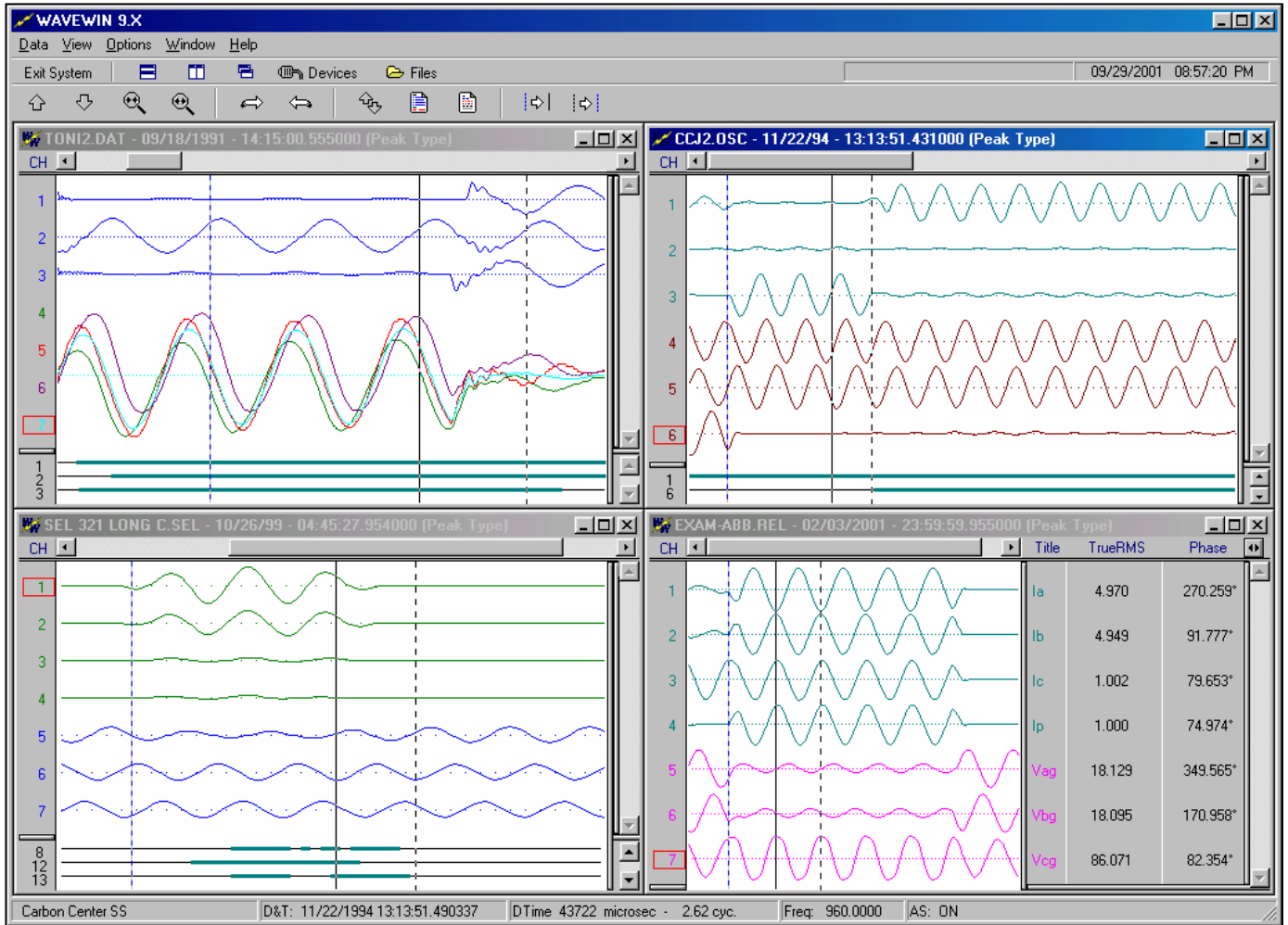


Figure-6, Universal Fault Records Display

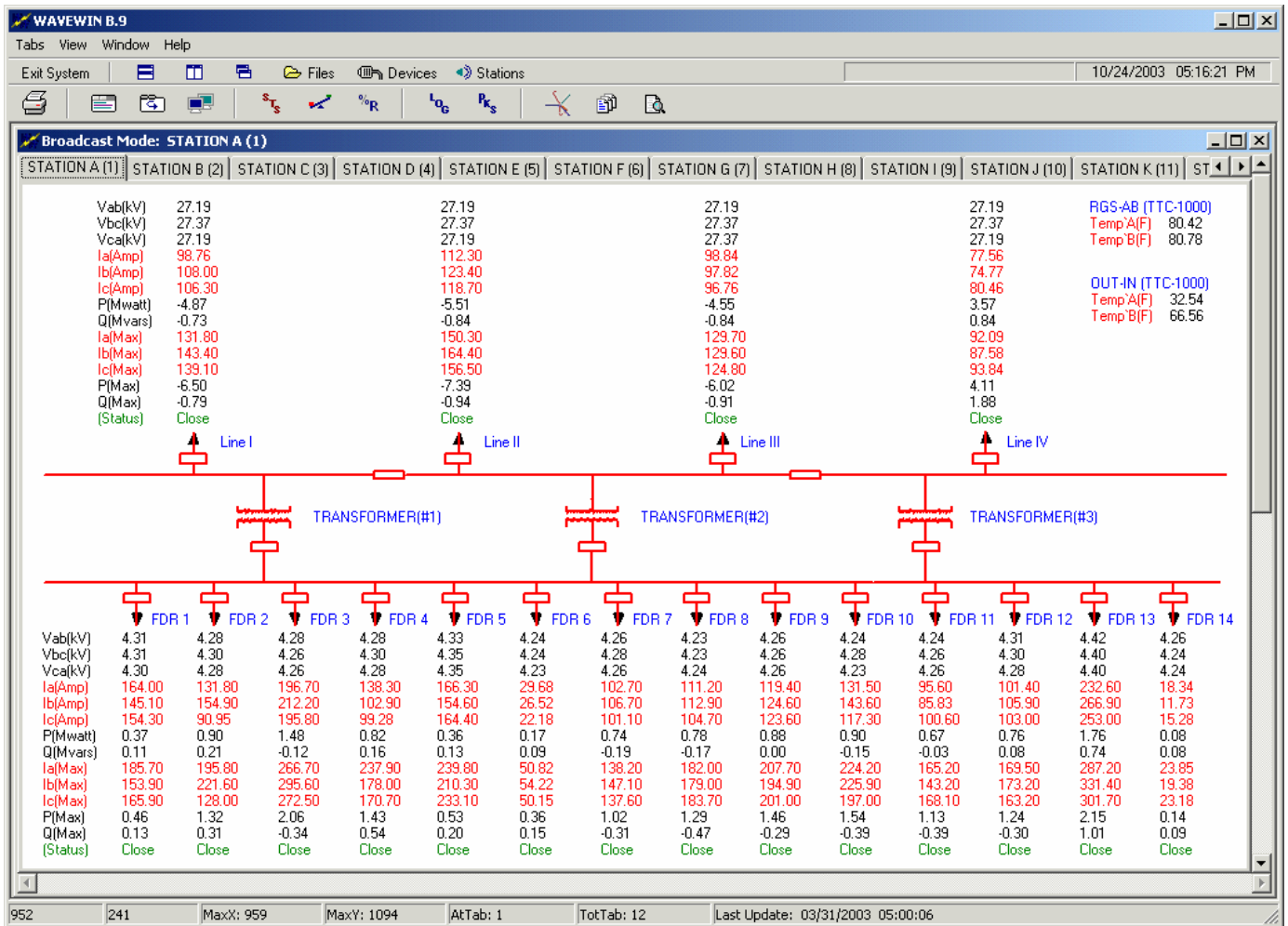
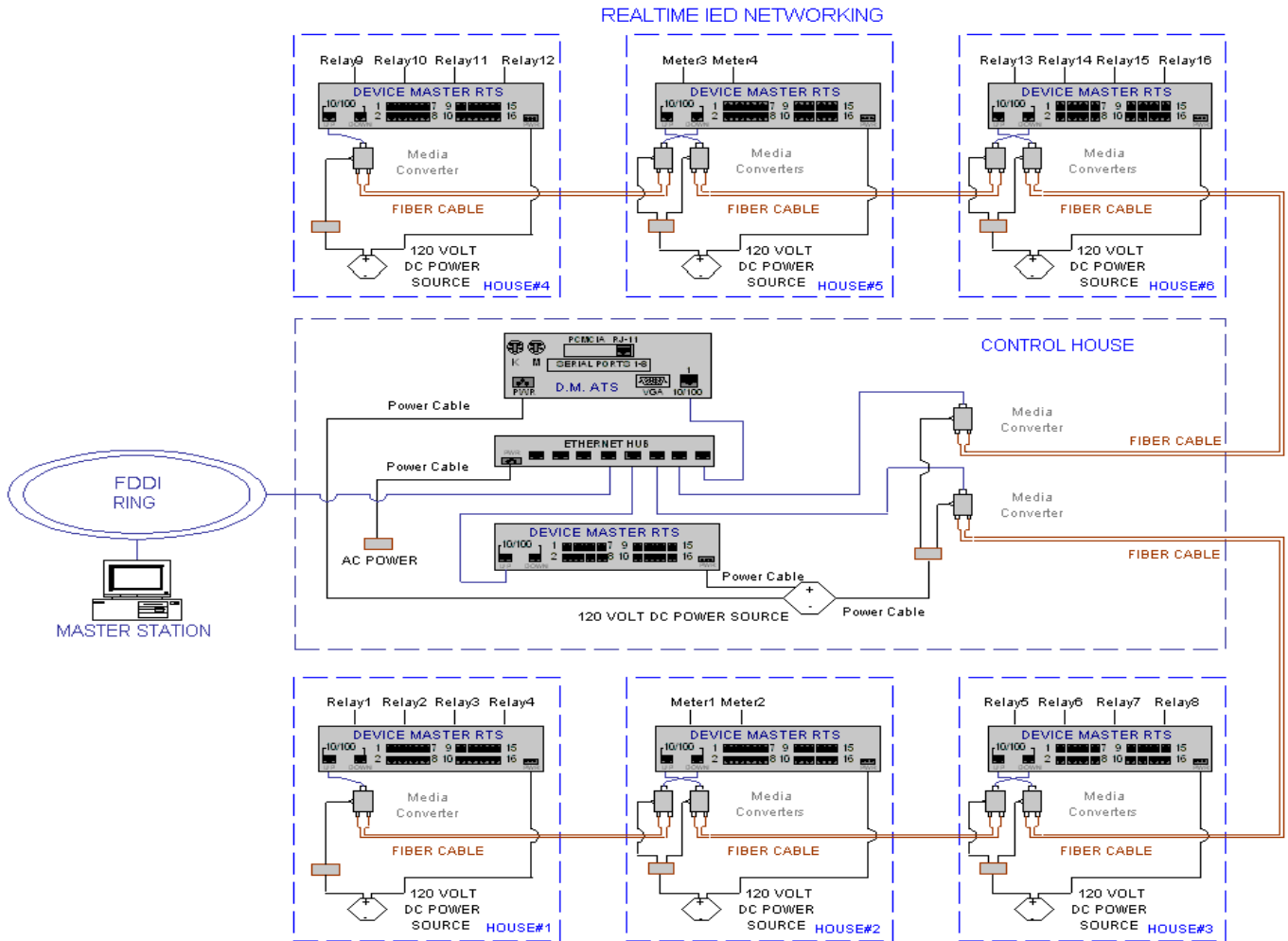


Figure-7, Station Diagrams with Real-time Values



Figure–8, SDC Diagram for Real Time Collection of Substation Data