Preventing Electrical System Pollution Before It Happens: The Electrical Pollution Screening (EPS) Program

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Power Quality Realities

- High profile customers and issues get the majority of the attention of experienced engineers
- Every-day “run of the mill” customers, their loads, and their potential for creating power quality problems are often overlooked ***until it is too late***
- Many front-line engineers have ability to address many PQ problems, but lack simple yet capable tools

The World of the “Field Engineer”

- Field engineers often use analysis tools developed by others with hooks into company databases
- Software tools have become less “desktop oriented” as laptop computers have gained widespread use
- Tools are not truly portable as network connections are often necessary for database access
- Common analysis outcomes are for the field engineer to recommended
  - Proceed with electric service—no cause for concerns
  - Gather more information and refer situation to a “higher level” for further study
  - Recommend that the customer be told something must be done prior to taking service

The EPS Tool

- A screening tool has been developed for field use that
  - Runs on Windows Mobile (PocketPC) handhelds
  - Utilizes corporate database information for substations and equipment
  - Provides motor starting, harmonic, and flicker analysis based on accepted standards and practices
  - Provides three-level recommendations regarding study results
  - Provides summary reporting of system and load data and results

Handheld Computing

- Performing calculations on a hand-held computer presents many interesting challenges
  - Screen size is severely limited
  - Only a single window can be open at one time
  - Data entry via small keypad or stylus is difficult at best
  - Processing power is minimal
  - Fully-functional operating system is not present

The EPS Main Screen

- The EPS tool is based on an assumed electrical system topology
- User selects or enters data by “tapping” relevant areas on the diagram

Hooking an XML Database

- Company data can be loaded from an XML database
  - Substations
  - Conductors
  - Transformers
- Data can also be manually specified

Entering System Data

- All typical equipment is loaded via XML files created from existing databases or spreadsheets
- User is free to select from existing data or specify unique values for everything

Conductors and Transformers

Secondary & Service Conductors

- For LV concerns, the impedance of service and secondary conductors may be important

Load Data

- The nature of the load is the critical piece of any PQ screening analysis
- Essential to not require “too much” information

Load Data

Analysis Methods

- Motor starting analysis is done by modeling the motor with its locked-rotor impedance
- Harmonic analysis is done using the concept of “weighted distorting power” as prescribed in IEEE 519.1
- Frequency scans are done using standard methods in IEEE tutorial publications
- Flicker analysis is done using
  - The concept of “fluctuating power” as prescribed in IEC 61000-3-7
  - The concept of “short circuit power ratio” as described in various IEC and CIGRE publications

Specifying the PCC

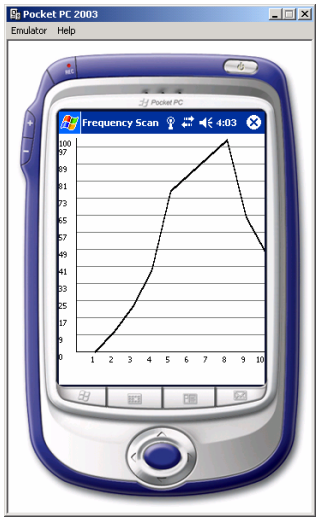
- User can specify point in system where results are evaluated

The Results

- Results include numerical values, indications of possible problems, and potential solution actions where necessary

Frequency Scans

- An indication of potential resonance is given via traditional line plots
- Detailed graphics are not possible given the small screen size



Text-Based Reporting

Additional Features

- Each screen has built-in help that provides detailed definitions of each data field, available options, expected units, etc.
- Company databases are packaged with the executable code and installed automatically on the PDA—user action is never required
- Analysis results and full details of equipment selections are provided in a text-based file which can be saved for study documentation

Present Status and Future Work

- The tool is presently used by engineers in PacifiCorp
- Detailed training manuals have been developed for both users and support personnel
- Technical enhancements are planned for flicker and harmonics so that more advanced conditions may be evaluated
- Public-domain distribution is being considered for the benefit of the industry at large
  - Some nominal fee may be charged and support is likely to not be provided to individuals
- A users-group forum is being considered where support needs can be addressed and future developments can be considered