The IEEE PES Power System Relaying Committee
What is it? What's Happening There? Why is it Important to you?

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Introduction

The Power System Relaying Committee (PSRC) is one of the 17 technical committees of the Power and Energy Society (PES) reporting to the PES Technical Council. The PSRC was established over 75 years ago as the repository for the standards and application guides pertaining to protective relays used in our industry. Lots of changes have come to the industry since the PSRC's inception and PSRC is changing to meet those needs. This paper will discuss a brief history of the PSRC, it's organization, where it fits into the Standards body, what it's doing currently, how it's evolving to meet your needs, and you can help.

History

In 1884 in response to a growing importance and interest in electric energy, the American Institute of Electric Engineers (AIEE) was established. In the early years of the organization relays were not mentioned. Fast forward to 1917, a major event in terms of protective relaying occurs. The minutes of a meeting in Chicago of the Committee on Protective Devices is devoted exclusively to relays and contains the following:

> "The discussion on the relay papers in Chicago indicated that a number of companies in the larger cities were rapidly changing their practices in the operation of transmission lines due to the development of relays. Heretofore most of these companies: have operated their lines radially. ... With the advent of the later types of relays, companies are now operating their transmission lines in parallel. ... They find that the relays are reliable for this service."

Our industry is born. In 1937 the subgroup became a subcommittee of the Committee on protective devices. Then on July 1, 1947 it separated from the Committee on Protective Devices and became the AIEE Relay Committee.

American Institute of Electrical Engineers

In 1963 the AIEE joined with the Institute of Radio Engineers (IRE) to become the Institute of Electrical and Electronic Engineers (IEEE).

Present Day
Today the IEEE has over 377,000 members in over 150 countries. It's the largest technical and professional society. The mission of the IEEE is :

1. Promote technology and allied sciences
2. Benefit Humanity through electro-technology
3. Promote Advancement of the profession
4. Facilitate Networking
5. Promote member interests

The IEEE is made up of 37 societies, 4 councils, approximately 1283 individual and joint society chapters, and 1156 student branches.

The Power and Energy Society (PES) is one of the 37 societies that make up the IEEE. It's the 3rd largest society with over 30,000 members. Within the PES are 21 committees. The Power System Relaying Committee is one of these committees. The current scope of the PSRC is :

Treatment of all matters in which the dominant factors are the application, design, construction and operation of protective, regulating, monitoring, synchronism-check, synchronizing, reclosing, and auxiliary relays, including all matters necessary to the function of such relays and relaying systems employed in the generation, transmission, distribution, and utilization of electrical energy and including the effects of such relays on system operation. Treatment of techniques and requirements for communications within, between, and among protective relays, to the extent that these communications affect protection functions or performance. Maintenance of liaison and collaboration as required with other committees of the Power & Energy Society and associated groups and Societies of the IEEE.

We'll get back to this later.

The PSRC is composed of 7 subcommittees:

B. Advisory
C. Systems Protection
D. Line Protection
H. Communications
I. Relay Practices
J. Rotating Machinery
K. Substation Protection

Scopes of the subcommittees:

Advisory
Scope: Assist the Chair of the PSRC on all matters that he may request in the functioning, direction, and conduct of the work of the Main Committee. (Main Committee Officers, Subcommittee Chairs past PSRC Chairs, and B Working Group Chairs)

System Protection
Scope: Evaluate protection system responses to abnormal power system states. Evaluate and report on special protection schemes, remedial actions schemes, monitoring and control systems and their performance during abnormal power system conditions. Recommend corrective strategies and develop appropriate standards, guides, or special publications. Evaluate and report on new technologies which may have a bearing on protection system performance during abnormal power system conditions.

Line Protection
Scope: Investigate and report on the relaying techniques and systems used for T&D line protection. Develop statistics and recommend protection practices for improving line relaying performance. Develop and maintain standards for line protection.

Communications
Scope: Evaluate and report on the characteristics and performance of protective relaying communications. Recommend communication requirements and operating, test procedures which assure reliable performance of the overall protective system. Report on new relaying equipment designs tailored to specific communication requirements

Relay Practices
Scope: Develop, recommend and establish standards on protective relaying practices which are compatible with the electrical environment, including, but not limited to, relay withstand capabilities to electromagnetic interference, characteristics and performance of instrument transformers, testing procedures, applications, performance criteria, and definitions of relays and relay systems.

Rotating Machinery
Scope: Evaluate and report on protective relaying concepts and practices applicable to generators, motors, synchronous condensers, associated auxiliary systems, and performance of plant protective systems. Develop and maintain related relaying standards.

Substation Protection
Scope: Evaluate and report on methods used in protective relaying of substations and the consumer or independent power producer, associated equipment and performance of these protective systems. Develop and maintain relaying standards which relate to this equipment and the utility-consumer interface.

Within the subcommittees are the working groups and task forces where the actual work gets done. Here's where Standards get created or revised, Application guides are created, and reports of interest to the Main Committee, or subcommittee are written. Some of the work is being presented at this conference during other paper sessions.

The committee meets three times a year in January, May, and September at different locations around North America. Attendance averages around 220 relay engineers from utilities, consultants, manufacturers, and universities. Everyone is welcome to attend. We average 20 new attendees per meeting.

What do we do?
At this writing, PSRC is the home for 45 (and counting) IEEE Standards and Guides. Standards and Guides have a lifetime of 10 years. Prior to the end of the 10 years the standard or guide must be updated and balloted. After successful ballot, the standard or guide is good for an additional 10 years.

The process of updating, or creating a guide or standard is a 5 year process. First, a task force is formed by the subcommittee assigned to the standard. The purpose of the task force is to review the standard and recommend whether one of three actions be taken: Withdrawn because it is no longer pertinent, or balloted as is as no updates need to be made, or form a working group to update the standard before balloting. To form a working group to conduct a ballot or update a standard, a Project Authorization Request (PAR) must be submitted to the IEEE Standards Association (IEEE-SA). This is done to track the progress of the standard and inform other technical committees, and societies of the work so they can become involved if desired. The PAR is valid for 5 years. During that time the standard is updated by the working group, and balloted. It may seem like a long time but it goes by very quickly. Ask anyone who has chaired a working group.

The task for updating a standard or creating a new standard is divided into three segments. First is the education portion, during this portion speakers present topics pertinent to the proposed standard. The purpose of this is to update the entire working group on the subject matter so that writing assignments can be made. This is one of the most valuable reasons for joining a working or PSRC. That is learning from industry experts, and your peers. Next is the actual writing of the standard. Writing assignments are volunteered or assigned to working group members on topics within the standard. These are reviewed at subsequent meetings and the standard begins to take shape. After the standard is complete, and it is acceptable to the working group, a request is made to IEEE-SA to form a balloting body.

Regarding balloting any one can participate in the balloting process. Membership to IEEE-SA is all that is required. By indicating your preferences, you will automatically be sent invitations to ballot.

After the balloting body is formed, and the completed standard is uploaded to the IEEE SA, the ballot begins. The ballot period is usually one month. It takes a 75% affirmative ballot by the balloting body for the standard to pass. If any negative ballots are received the must be addressed and reconciled if possible. The next portion of the working group life is ballot resolution. During this time all the comments received during the ballot are addressed by the working group, and the document is revised. After revision, it's balloted. If successful, the standard is forwarded to IEEE SA for final approval before publishing.

The working group's task is completed after the standard is published. It may continue to write a Transaction paper announcing the standard, or write a paper to present at regional conferences, or create a tutorial to present at conferences such as the IEEE PES General Meeting or IEEE PES T & D Conference.

On occasion a subject is too new to write a standard or guide. In these cases a report can be written to the subcommittee, or Main Committee. The working group follows a similar path to standards development working groups: Education – Writing assignments – consensus. However, the consensus process is similar to the balloting process but is less formal. It's just limited to first, the working group, and later, the subcommittee, and finally, officer approval. At a later date these reports can be reopened and converted to application guides. Then the process repeats.

Here are some current projects in our subcommittees :

C System Protection Subcommittee

C2 Role of Protective Relaying in the smart Grid

Assignment: Identify the functions and data available in Protective Relaying Devices that are used at different functional levels and different applications and can be used within a Smart Grid.

Describe the use of interoperable data formats for protection, control, monitoring, recording, and analysis.

C4 Guide for Phasor Data Concentrator Requirements for Power System Protection, Control, and Monitoring (PC37.244)

Assignment: Develop a guide for performance, functional, and information communication needs of Phasor Data Concentrators for power system protection, control, monitoring, and information management. The Guide will include system needs for PDC applications, configuration, and testing procedures.

C14 The use of time synchronized measurements in protective relay applications

Assignment: Produce a general report to PSRC Subcommittee C outlining practical protection applications using synchrophasors.

C16 Relay circuit design using microprocessor relays

Assignment: Write a supplement to the existing 1999 relay trip circuit design paper as an IEEE report to address microprocessor relays

C17 Fault current contributions from wind plants

Joint WG Assignment: To characterize and quantify short circuit current contributions to faults from wind plants for the purposes of protective relaying and equipment rating, and to develop modeling and calculation guidelines for the same

D Line Protection Subcommittee

D6 AC Transmission line parameter model verification

Assignment: The WG will prepare a report to the main committee on the processes, issues, problems and methodology of validating software model parameters for AC transmission lines used for relaying. The report will not include details of relay curve models or other similar relay modelling. The report will also not include specific EMTP modeling.

D19 PC37.113, DRAFT Guide for Protective Relay Applications to Transmission Lines

Assignment: Concepts of transmission line protection are discussed in this guide. Applications of these concepts to various system configurations and line termination arrangements are presented. Many important issues, such as coordination of settings, operating times, characteristics of relays, impact of mutual coupling of lines on the protection systems, automatic reclosing and use of communication channels are examined. Special protection systems, multi-terminal lines and single phase tripping and reclosing are also included. The impact that system parameters and system performance have on the selection of relays and relay schemes is discussed as well.

D25 Distance element response to distorted waveforms

Assignment: Write a technical report to the Line Protection Subcommittee on the performance of distance elements with distorted waveforms.

D27 Guide for the Application of Digital Line Current Differential Protective Relays Using Digital Communications PC37.243

Assignment: Write a “Guide for Line Current Differential Protective Relay Applications” to present practical line current differential schemes including operating principles, synchronization methods, channel requirements, current transformer requirements and external time reference requirements; provide specific guidelines for various application aspects including multi-terminal lines, line charging current, in-zone transformers and reactors, single-pole tripping and reclosing as well as channel and external time sources requirements; include backup considerations, testing considerations and troubleshooting.

H Communications Subcommittee

H1 PC37.236 Guide for Power System Protective Relay Applications over Digital Communication Channels

Assignment: Develop a guide for application of digital communications for protective relaying systems and schemes, including transmitting and receiving equipment, digital channels, application principals, performance, installation, troubleshooting, testing and maintenance.

H4 Revision of C37.111 COMTRADE Standard

Assignment: Revision of IEEE Std C37.111-1999 - IEEE Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems.

H11 C37.118.1 Standard for Synchrophasors for Power Systems

Assignment: Create a new Synchrophasor Standard C37.118.1, using the measurement portion of the current standard, C37.118-2005, and adding dynamic phasor measurement and frequency measurement requirements according to the PAR issued 17 June 2010.

H12 Configuring Ethernet Communications Equipment for Substation Protection and Control Applications

Assignment: Develop a report to assist protection engineers in configuring Ethernet LANs and networking equipment when the network traffic includes critical protection messaging such as IEC 61850 GOOSE messaging. Topics include switch and router configuration, VLANs, security, priority queuing, traffic monitoring and control, and topology choices and redundancy.

H13 Understanding Requirements and Applications of the Substation Cyber Security Standards (Joint Working Group Substations Committee C10 & PSRC H13)

Assignment: Prepare a standard on "Cyber Security Requirements for Substation Automation, Protection and Control Systems." This document provides technical requirements for substation cyber security. It presents sound engineering practices that can be applied to achieve high levels of cyber security of automation, protection and control systems independent of voltage level or criticality of cyber assets. Cyber security includes trust and assurance of data in motion, data at rest and incident response.

I Relaying Practices Subcommittee

I7 Revision of C37.103 Guide for Differential and Polarizing Circuit Testing

Assignment: Revise and update the IEEE Guide C37.103 – Guide for Differential and Polarizing Circuit Testing

I11 PC37.241 – Guide for Application of Optical Current Transformers for Protective Relaying

Assignment: Develop Guide for "Application of Optical Instrument Transformers for Protective Relaying"

I12 Quality Assurance for Protection and Control (P&C)

Assignment: "To develop a special report outlining the best practices of quality control for protection and control design drawing packages from conception to final "as-built".

I21 Analysis of System Waveforms and Event Data

Assignment: Prepare a report that will define a process for identifying and analyzing a fault incident. The process will include data collection, analyzing techniques, and methods of reporting.

I22 End of Useful Life Assessment for P&C Devices

Assignment: Prepare a PSRC report on the criteria for determining the end of life for protection, control, and monitoring devices including electromechanical, solid-state and microprocessor-based devices.

J Rotating Machinery Subcommittee

J2 Protection Considerations for Combustion Gas Turbine Static Starting

Assignment: Deliver a paper or report on special protection requirements on generators employing load commutating inverter (LCI) static starting.

J5 Application of Out-of-Step Protection Schemes for Generators

Assignment: Produce a summary and full report to the ”J” Subcommittee explaining the various schemes and setting guidelines in use for Out-of-Step protection for AC generators. The report (summary) should be in the format that could be used as feeder material into the next revision of C37.102-IEEE Guide for AC Generator Protection.

J7 Avoiding Unwanted Reclosing on Rotating Apparatus

Assignment: To review and provide comment on the protection and control vulnerability known as “Aurora”

JTF8 Improved Generator Ground Fault Protection Schemes

Assignment: To review new methods related to generator ground fault protection.

K Substation Committee

K1 PC37.245 Guide for the application of protection to phase shifting transformers

Assignment: To write a guide for the application of Protective Relaying for Phase Shifting Transformers (PSTs). The protection methods for different types of PST and operating conditions of PSTs will be reviewed. Representation of PST models to determine short circuit currents for relaying considerations will be considered. Protection CT sizing and location issues will be considered. Relay application and setting examples will be provided.

K5 (PC 37.119.2005): IEEE Guide for Breaker Failure Protection of Power Circuit Breakers

Assignment: To revise and update C37.119-2005 – IEEE Guide for Breaker Failure Protection of Power Circuit Breakers.

K6 Sudden pressure protection for transformers

Assignment: To complete a technical report to the Substation Protection subcommittee on the application of sudden pressure relaying in power transformers.

K11 Open Phase Detection for Nuclear Generating Stations

Assignment: Write a report to the K Subcommittee entitled Methods for Analyzing and Detecting an Open Phase Condition of a Power Circuit to a Nuclear Plant Station Service or Startup Transformer.

Any of these working groups are open to any IEEE PES member. The ideas for the working groups come from several sources. First, members of the subcommittee may propose a new working group. If enough members of the subcommittee show interest a task force is formed. The task force does an informal investigation and recommends back to the subcommittee to either form a working group, or recommends that the topic be dropped. If the recommendation is to form a new working group, the task force proposes an assignment for the working group which is then voted on by the subcommittee.

Second, new working groups may originate from outside sources that look to the PSRC for guidance. An example of this is the NERC System Protection Subcommittee asked PSRC to investigate the phenomena of relay operations at reduced frequency and voltage. This was a result of some of the findings from the 2003 Northeastern US blackout investigation. A working group, D22 was formed and a few years later, a report was written in response to the request. “Performance Specification and Testing of Transmission Line Relays for Frequency Response” was the result.

Other times PSRC is asked to absorb work done by other entities make then into standards. Some of the PMU standards got their start in this fashion.

Membership

Several mentions of Main committee members, subcommittee members, and working group members have been used in the discussion. A brief definition and requirements of each are needed.

The entry level is the working group member. Anyone is allowed to attend a working group meeting. From there one has the option of being a guest and just listen to the proceedings, or join, and become an active member. A member is required; to attend at least 2 of the 3 meetings a year, participate in writing assignments, review the document, and vote in a timely manner when needed.

After a few years of working group contributions and attending subcommittee meetings on a regular basis, one becomes eligible to join a subcommittee. Subcommittee membership is by invitation of the subcommittee chair. As a subcommittee member one can vote on proceedings at subcommittee meetings, approve reports to the subcommittee, and propose new task forces.

Main committee membership is the highest membership level for the PSRC. Main Committee members can vote on motions at the Main Committee meetings, propose actions, review papers submitted for the IEEE PES conferences such as the General Meeting , and T&D Conference, and become officers. Main committee membership is by invitation from the PSRC Chair. Criteria for membership is two years active work on subcommittees, and a recommendation from the subcommittee chair.

What does the future hold?

As stated previously, PSRC is just one of the 17 technical committees that report to the Power and Energy Society Technical Council. The scope for the operation of PSRC is approved by technical council. That is, any changes in scope proposed by PSRC must be approved by Technical Council. I say this as an introduction to the topic of the future.

When the PSRC was established over 75 years ago, relays were very simple electromechanical devices that perform single functions. It did protection. As the years went by the relay went through several evolutions from solid state systems to our world of microprocessor relays today.

Today, relays are called upon to do much more than protection. They monitor and report system conditions, record analog and digital information for fault analysis, talk to other peer relays, control circuit opening devices during non-fault conditions, and take on SCADA RTU functions. Looking at what relays do today versus what is in our current scope, and some of the non- relaying areas our working groups are doing, such as Phasor Measurement Unit operations, and Data Concentrator specifications. Since many of our working groups are working in fringe areas, there are several joint working groups with C0, a subcommittee from the Power Systems Substation Committee. C0's scope includes among other things, DNP, SCADA, and RTU's. It's obvious that our scope needs to be expanded.

The PES Tech Council has commissioned a task force to investigate if the technical committees are covering all the areas in the smart grid, and new technologies that need be addressed. The task force is also looking at the current technical committee organization to see if it meets the requirements of future electric power systems. Unfortunately, the output report from this task force is a year away at best.

The officers of the PSRC have already proposed to the PES Tech Council that our technical committee absorb C0 and be renamed the Power System Protection and Control Committee with a scope as follows:

Treatment of all matters in relating to the application, design, construction and operation of protective, regulating, monitoring, reclosing, synch-check, synchronizing and auxiliary relays, plus matters relating to the data acquisition, processing and control systems within substations. Including matters necessary to the functioning of relays and relaying systems employed in transmission, generation, distribution and utilization of electrical energy and their effect on system operation. Control systems include transducers, Intelligent Electronic Devices (IEDs), Human Machine Interfaces (HMIs), and communication networks. These matters include the low-level interfaces to and protocols communicating locally and remotely with these systems. Cyber security and the environmental phenomena that can adversely affect these systems are included. Maintenance of liaison and collaboration as required with other committees of PES and associated groups of IEEE.

This proposal is on hold pending the outcome of the Technical Council task force recommendations.

Until then, the PSRC will keep moving forward. We meet three times a year; in January, May, and September in various locations across North America. We are always looking for new members with new ideas. Won't you consider coming to our next meeting in New Orleans in January?

Roger Hedding is the 2013 – 2014 chair of the Power Systems Relaying Committee.