2010 Professional Development Award Report

Western Protective Relay Conference

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Contents

Acknowledgements

I would like to extend my heartfelt gratitude to the Electricity Engineers Association (EEA) for giving me an opportunity to attend the Western Protective Relay Conference in Spokane, USA. I would also like to thank the management at Electricity Ashburton Limited (EAL) for supporting me to participate in this event. Without EEA's and EAL's support, I would not have made it to the conference. I am also thankful to all others who helped me to plan my trip. I also appreciate the WPRC conference organisers, and others who shared their knowledge and experience with me.

Introduction

37th Western Protective Relay conference was held in Spokane, Washington, USA. The conference provided a forum for the presentation and discussion of broad and detailed technical aspects of protective relaying and related subjects. This forum allows participants to learn and apply advanced technologies that prevent electrical power failures.

As part of the EEA professional development award I had an opportunity to attend the conference. A number of presentations and training sessions were held at the venue. Approximately 400 people attended this event. Most of the participants were from North America but there were a number of people from other countries as well (Spain, Brazil, Mexico, Australia, and Africa). The conference was attended by relay technicians, consulting engineers, protective relay engineers, switchgear and switchboard manufacturers, IT professionals, managers, chief executives (CEOs), researchers, faculty and students.

The main conference was divided into two concurrent parts i.e. paper presentations and breakout sessions. Paper presentations were mainly focussed on case studies, new technologies, lessons learned etc. whereas breakout sessions were targeted towards the training of upcoming protection engineers as well as other power system engineers. Attendees could choose to attend any papers or training sessions as per their interests and relevance.

The conference program started on 17th Oct 2010. A welcome reception was organised by Schweitzer Engineering Laboratories (SEL) at the Davenport hotel. Most of the conference attendees were present at this reception. It was a good opportunity to mingle and make some friends before the main conference. SEL also organised a day seminar on 18th Oct where the president of SEL, Edmund Schweitzer talked about the latest technologies in protection relays and the changing demands within the stricter regulatory environments. Various other presentations were given by other senior SEL personnel on a range of protection topics. In the afternoon session, attendees had an opportunity to participate in one of the many SEL organised training sessions. In the evening at the Red Lion hotel, attendees had further opportunities to socialize with many conference attendees and various vendors and their products. Many companies (heard and unheard) had their products or technologies on display in the hotel's suites and it was a great opportunity to further discuss and learn about the latest in power system protection.

Western Protective Relay conference was highly beneficial to make contacts, learn about both existing and new technologies, and have insights into various application aspects of protective relaying and systems. The discussion and the papers presented at the conference were highly valuable. It is definitely an experience that will always stay in my memory.

Further, I believe the knowledge and the experience gained from the conference will help me to effectively contribute to the existing and the future protection systems at EAL. Other relevant points are outlined where appropriate.

Conference Programme

There were many interesting papers (55 in total), breakout sessions, and products on display at the conference. I attended some of the key presentations and the training sessions. The following is the highlights of some of the key presentations that may be of interest to the EEA readers. A summary of the two training tracks are also given in the report.

SEL Seminar: 18th Oct 2010

Morning Session:

1. Welcome and Company Update

The welcome speech was given by Edmond Schweitzer, the president of SEL Corporation. He discussed various challenges of protection technologies due to stricter regulatory requirements. He also emphasized the role of SEL in the protection industry.

2. Best Maintenance Practices to meet NERC requirements

The presentation was focussed on the requirements of North American Electric Reliability Corporation (NERC) standards on the best practises for maintenance testing as well as the benefits of commissioning and events analysis.

One of the NERC protection maintenance requirements (PRC-005-2) recognises the fact that it is important to develop a plan and test the entire protection systems not just the relays. It includes breakers, dc supply systems, relays, current transformers (CTs), voltage transformers (VTs), Communication systems and all associated wiring. The following points are the summary of the message given by PRC-005-2-

1. Identify Protection System Components
2. Develop a Protection System Maintenance Program which verifies, monitors, tests, inspects, calibrates, maintains, and restores.

To some extent, the main protection testing requirements were similar to NZ Electricity commission requirements. However, PRC-005-2 emphasizes the establishment of Protection System Maintenance Program (PSMP) using a combination of-

1. Time-based maintenance (TBM) - For relays without self monitoring or alarms functionalities.
2. Condition based maintenance (CBM)- For relays with self-monitoring (daily)
3. Performance-based maintenance (PBM)- For relays with continuous self monitoring (within one hour)

The presentation also discussed the IEEE guidelines on combining the three test methods for optimum results.

3. Advances in Line Protection- New SEL-411L for High Speed Line Differential Protection

The presentation discussed the advancement in Line protection with SEL's state of the art high speed line differential realy i.e. SEL-411L relay. The presentation not only highlighted the alpha plane operate/restrain characteristics for various applications (multi terminal/2 terminal, dual breakers, high resistance fault etc.) but also its other advanced features such as sensitivity of negative and zero sequence differential elements, line charging current compensation etc. and the research and the development behind it.

NZ utilities can investigate SEL-411L further for its suitability in their network due to its alpha-plane characteristics. However, the author believes that the cost benefit analysis is essential before deciding on the suitability of any relays for any protection schemes.

Afternoon Breakout Sessions

There were multiple breakout sessions in the afternoon. The key points from some of the sessions I attended are given below -

4. In Depth Event Analysis- New Software and Events

The objectives of this interactive session were to learn-

1. Fundamental protection concepts through event analysis
2. Gain experience in methodical root-cause analysis, software use, and documentation techniques
3. Solve problems and develop proficiency through active participation

Events data from the real-world installations were analysed thoroughly. The session started with an introduction of events analysis in older electromechanical, solid state and microprocessor based relays. Utilities events data were illustrated to demonstrate the root causes of events. SEL recommended that event analysis should be an integral component of any relay testing philosophy. Event analysis assists the power system engineer to continuously improve power system availability.

The following steps are recommended while doing any event analysis –

1. Prepare For Analysis – The first stage in analysing an event is to understand the expected operation for a particular power system event.
2. Collect Information – The next step is to collect information from various sources. This may include notes from faultsman, SERs, target, display, DFRs, and relay event reports. A number of automated tools (For e.g. - Accelerator Team) are available to assist technicians and engineers to properly analyse events.
3. Start your analysis using all the available resources i.e. instruction manuals, references, other event viewing tools etc and find the root cause.

Many utilities in New Zealand can also make the best use of SEL's TEAM software to automate the extraction of events data. This application is also cost effective. EAL is evaluating the TEAM software at the moment for its event analysis and protection testing purposes. It was quite interesting to learn that even though the TEAM software is dedicated to the SEL relays, it can also be used to communicate with other relays (it may need some extra coding and it can be complex). General Electric (GE) has similar software which can be used to talk to its relays and extract events data automatically.

5. Maximizing Speed and Security with Innovative Line Differential Protection

This session was divided into various modules. In this session, first the principle of line differential current was discussed. Then its application in two, three and four terminal lines was explained. Various 87L channel options were also discussed. Key requirements of line differential protection channels were –

1. Availability (present and working as expected)

2. Low latency
3. Security (low bit-error rates)
4. Symmetrical versus asymmetrical
5. Compatibility of interface
6. Low losses if direct long-haul fibre

Design challenges of line differential protections were illustrated in details. The key challenges are –

1. Distributed (but tightly coupled) protection scheme- calls for data alignment
2. Low-bandwidth channels
3. Channel asymmetry
4. Security
    - Power System events
    - Communications events
    - Time events

Innovative alpha plane differential characteristics were illustrated. SEL emphasized that the alpha plane characteristics has great benefits over percentage differential as alpha plane is less immune from synchronisation errors, and CT saturation. High speed operation and easy to test are other benefits of this line differential scheme.

One of the interesting modules was about the testing of line differential schemes. As the communication system is involved in the scheme, the test requirements are complex than any other schemes. Channel characteristics, multiplexers, and external clocks can impact data exchanges. GPS synchronized test sets requires crews at multiple line terminals. The risks of error during testing of an in-service line can produce an unwanted trip. The built in features for communications and metering can be useful as verification tools.

Main Conference: 19th Oct 2010-21st Oct 2010

1. The evolution of Backup Protection in BC Hydro

The presentation highlighted the changing practices of BC Hydro with regard to backup protection to ensure dependability without compromising security. The presentation started with an introduction of backup and redundant protection systems. Redundancy of protection systems must be justified both in terms of costs and the requirements. In many situations, it may not be necessary for a very high protection performance and in such cases, backup protection may be a cost effective solutions without compromising the highest performance (with the primary protection). The choice of back up protection, no backup protection and redundant protection depends on a number of factors –probability of double contingency, probability of faults, the cost, regulatory requirements, self monitoring features etc.

Prior to the use of microprocessor relays, BC Hydro had the practice of using three phase, two phase and one ground relays. Two phase relays did not provide any redundant relaying for some phase faults. Also due to the requirements of higher phase overcurrent settings, the bus protection did not provide dependable backup for multiphase feeder faults. The use of multifunction microprocessor relays improved BC Hydro's ability to backup downstream protections on the feeder. The use of inverse time negative sequence overcurrent elements increased the sensitivity for feeder phase-phase faults. The use of definite time elements increased the speed of operation at low magnitude feeder fault currents and also provided adequate co-ordination with downstream fuse/recloser.

The presentation also provided examples of backup protection for feeder schemes, and transformer protection. One of the interesting things the presenter talked about was BC Hydro's policy regarding the removal of sudden pressure protection from the main tank as transformer differential protection was superior in speed and security. They also later applied dual differential protection systems to all power transformers.

The implementation of any protection schemes must be weighed against the total cost of implementing that scheme. Some distribution stations at BC Hydro are large, serving loads upto 300 MVA and the fault level is also very high i.e. 40kA. It justifies the need for BC Hydro to have a faster and more selective backup protection or a redundant protection.

Other operational issues at BC Hydro were also discussed. For a redundant system it is important to group alarms into separate primary and standby alarms (not just single alarms). Alarms were also classified as critical and non critical failures. These kinds of information allowed the operators to have different responses to individual alarms. In conclusion, BC hydro uses selective approach when it comes down to choosing the need for backup or redundant protection systems.

The application of backup and redundant protection systems in NZ may not be easily justifiable in terms of cost and benefits and therefore each utility may need to look at individual project on a case by case basis.

2. Utility Experience with Zero Sequence Mutual Coupling (Zom) for Parallel 230kV Underground Lines

This was one of the interesting presentations of the conference and it was presented by Girolamo Russelli from San Diego Gas and Electric (SDG), California. He discussed about the challenges of zero sequence mutual coupling in a project involving circuits with combination of underground cables and overhead lines. The main protection was line differential with a POTT scheme as a backup. The stage 1 and stage 2 of the project looked like Fig.1 and Fig.2 –

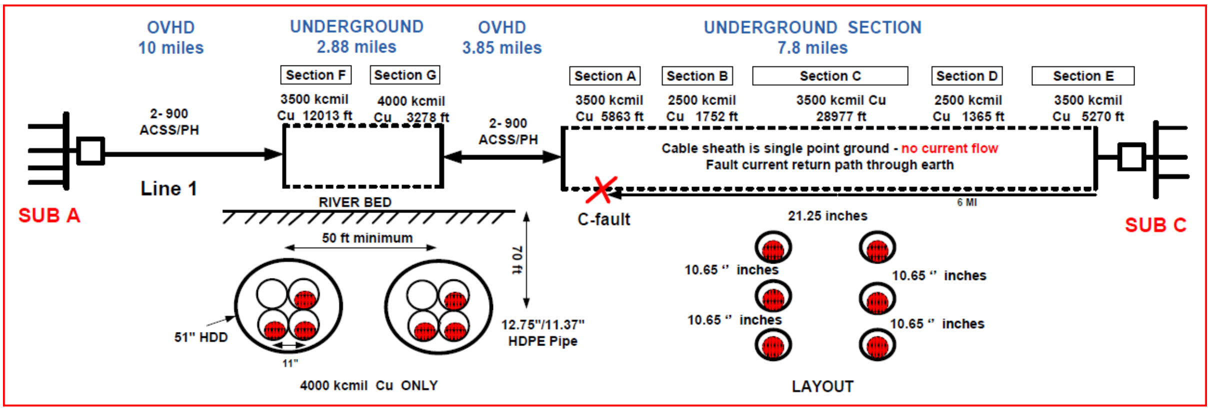

Fig. 1

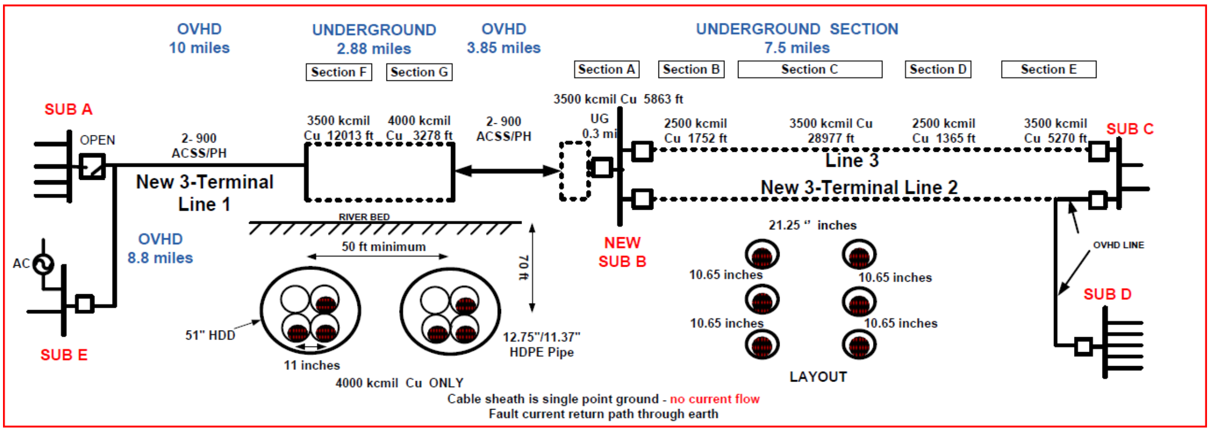

Fig. 2

When a single phase to ground fault occurred on a cable section, the relays indicated false faults location and currents. It was assumed that a fault location would not be within the underground network. The zero sequence mutual coupling was not modelled in the short circuit program and the expected fault currents seen by the relays events and Digital Fault Recorders were also much higher (3:1).

The presentation then discussed the importance of understanding the zero sequence mutual impedance between the two phases and three phase conductors. The manufacturer supplied value was multiplied by a factor of 3 for the equivalent per phase zero sequence mutual coupling and when this was used in the short circuit model, a good approximation for all of the different current flows was obtained.

A further line test result showed that positive sequence resistance and reactance were in line with the calculated values. However, the values reported by the testing company was substantially different in reactance values (Line 2 and 3) i.e. calculated reactance value was 24 ohms and the measured/tested value was 10.91 ohms. To sort out the differences in the calculated values, fault currents, and impedances, SDG hired a consultant to review the impedances for the lines. The following lessons were learned –

- Always review cable manufacturers data
- Test the new underground cable for the self parameters
- Do not delay to ask consultant to review the project or event who can quickly point out the potential problems

- Use the short circuit program to validate the fault currents and results. Compare with values obtained from Relays or Digital Fault recorders.

With proper modelling of zero sequence mutual coupling impedances, it is possible to obtain accurate faults locations and reduce outage times.

3. Using Hall Effect Sensors to Add Digital Recording Capability to Electromechanical Relays

This was another interesting presentation. The presentation described the use of Hall-Effect sensors in recording information from the major substation equipment such as electromechanical relays, circuit breakers, and power transformers. Various case studies were presented along with the characteristics and the process of using them in the substation environment.

Hall Effect sensors use small, current-to-voltage transducer that respond to magnetic fields. The transducer output voltage is -2.5 to 2.5 volts with 10 microseconds response time making it capable to measure high order harmonics. The transducer is also capable of measuring voltage upto 1 millivolt for every 20 milliamps of induced current with a maximum sensing current up to 50 Amps.

A power system simulator test with Hall-effect Recorder and a numerical relay showed that the fault records were similar in both instruments. The figure below shows the captured “A” phase waveforms from each instrument.

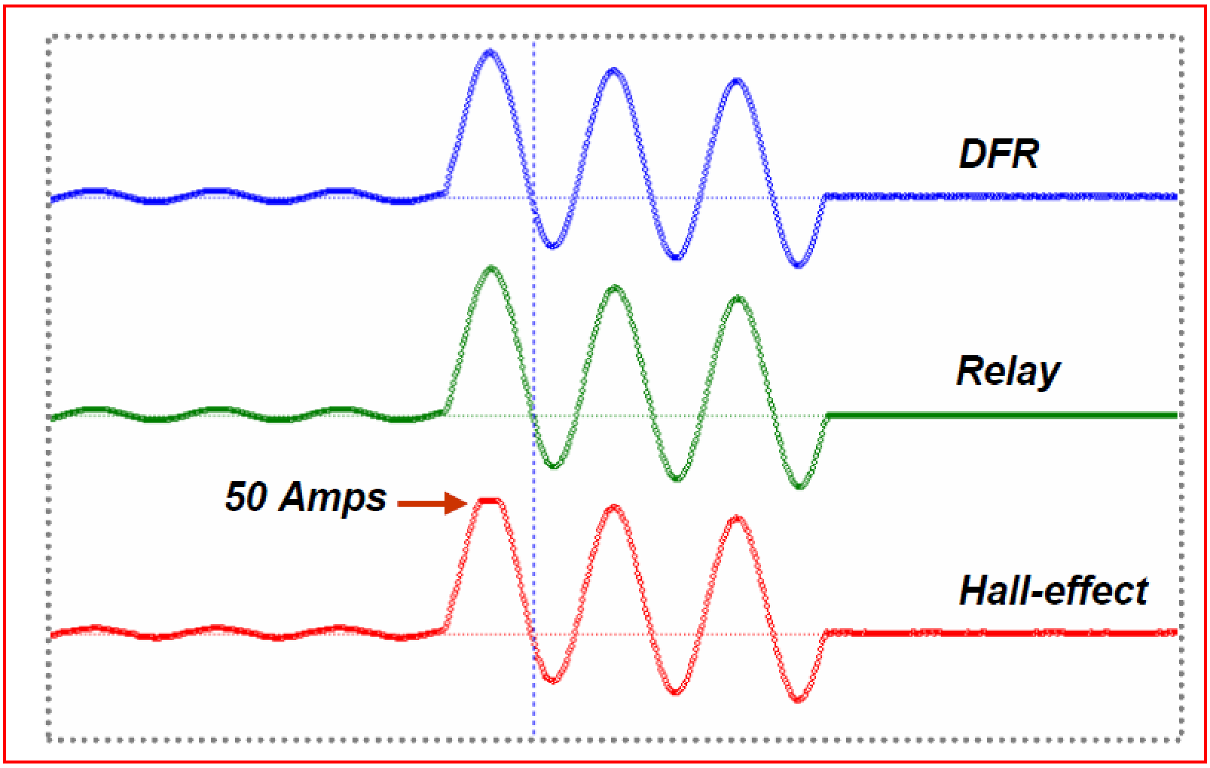

Fig.3

The case studies were illustrated for generator transformer differential protection, capacitor bank, and breaker timing. The findings were remarkable. The waveform data captured by the Hall-effect sensors for all three cases are given below.

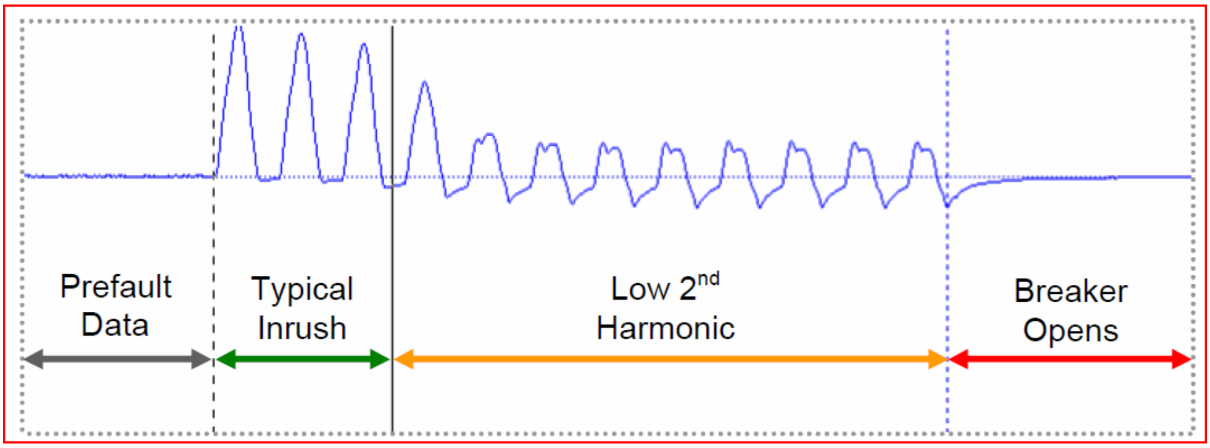

Fig. 4: Transformer inrush capture

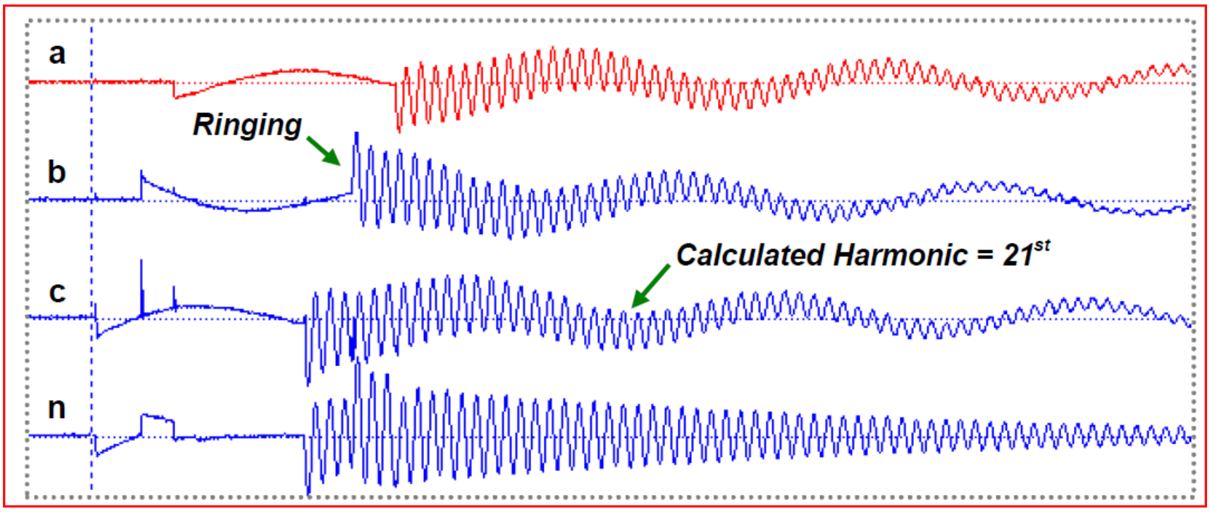

Fig. 5: Capacitor bank

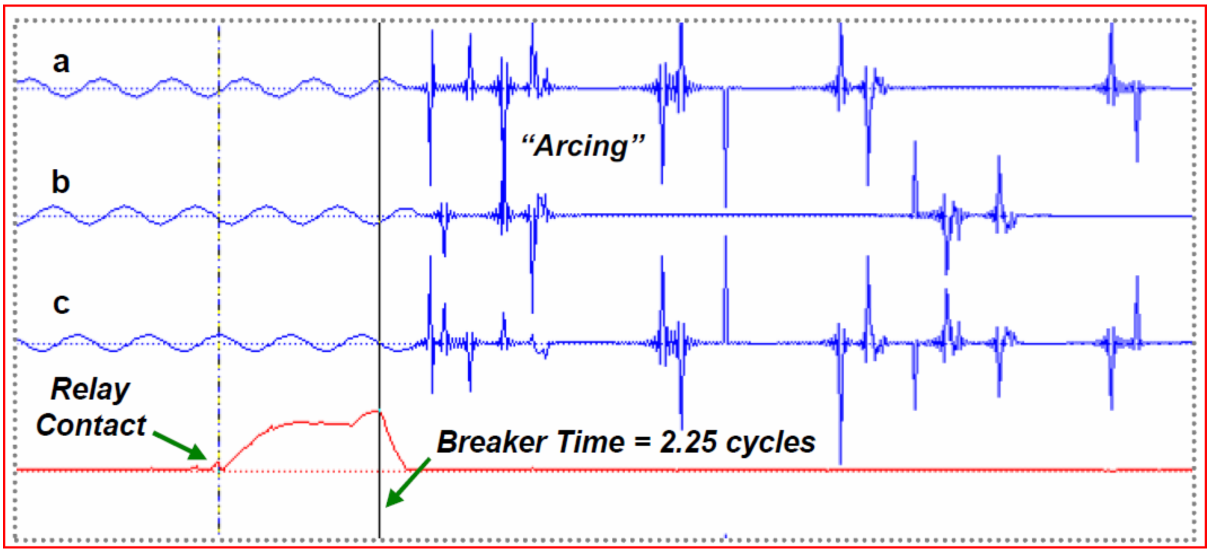

Fig. 6: Breaker timing

Many utilities in NZ still use Electromechanical relays and it maybe beneficial to install these sensors to capture the digital signatures for event analysis.

4. Fundamentals of Transformer Inrush

The presentation illustrated a detailed transformer inrush phenomenon and its impact on differential relays. Other topics such as modern differential protective techniques, impact of residual flux and higher efficiency core designs, restraint methods etc. were also covered.

Differential protection is based on a simple principle in which the sum of all winding currents should be zero for normal operation. However, this is not always true due to CT accuracy, CT saturation, tap changer operation, transformer losses, and inrush current. The presenter tried to initially show the differences between the CT saturation and the transformer inrush phenomenon. In both situations, transformer differential relays can misoperate due to unequal flow of currents in the two windings. The exact magnitude of inrush current is hard to predict as the flux produced due to excitation voltage depends on several factors such as residual flux, point on wave switching and the transformer design. The inrush current can be several times the full load rating of the transformer and may last for several seconds or minutes. As the flux and hence the inrush current produced during energisation or deenergisation depends on point on wave switching, the transformer inrush current becomes an unpredictable variable.

There are other factors which affect the inrush current for e.g. system impedance, transformer design etc. Inrush currents are typically caused by three events- transformer energisation, inrush due to fault clearing, and sympathetic inrush. The most severe impact is due to transformer energisation as the excitation voltage is very large. Inrush current produced due to fault clearance is not so severe because the magnitude of voltage change is not so high compared to the case of energisation.

The presenter also highlighted the importance of restraint methods for various levels of inrush current. The most common techniques such as percentage of total harmonics, 2^{nd} and 4^{th} harmonics percentage of fundamental, adaptive restraint, dwell time method were also discussed. No matter what the restraint method is, it is important to ensure that the dependability, security, and speed of differential relays are intact and a reasonable compromise is made to achieve the other.

5. Fundamentals and Improvements for Directional Relays

This was also one of the interesting presentations. The presenter discussed the fundamentals, limits to sensitivity, and the directional element design, and its application during loss of voltage conditions etc.

It was interesting to note that the quadrature-polarized phase directional relays could misoperate for a reverse phase to ground fault when the remote infeed current is largely zero-sequence. Also, the application of zero sequence and the negative sequence voltage polarisation in Electromechanical and Microprocessor relays were discussed.

Directional relays have evolved over many years and are more sensitive and flexible. Automatic settings for directional elements can be very helpful if applied correctly. Newer directional elements can be also used for Loss of Potential conditions.

6. IEEE PSRC Report on Global Industry Experience with System Integrity Protection Schemes

This presentation was the summary of IEEE Power System Relaying Committee report, Working Group C4, on system integrity protection schemes (SIPS) survey. The survey was done on a global scale with participations from CIGRE and IEEE members.

SIPS are the comprehensive and strategic protection schemes which are installed on different parts of the network to protect the overall integrity of the power system. It is not just a specific protection for a local power system element (for e.g. line, transformer, generator, bus bar etc). A typical high level layout of SIPS model is given below-

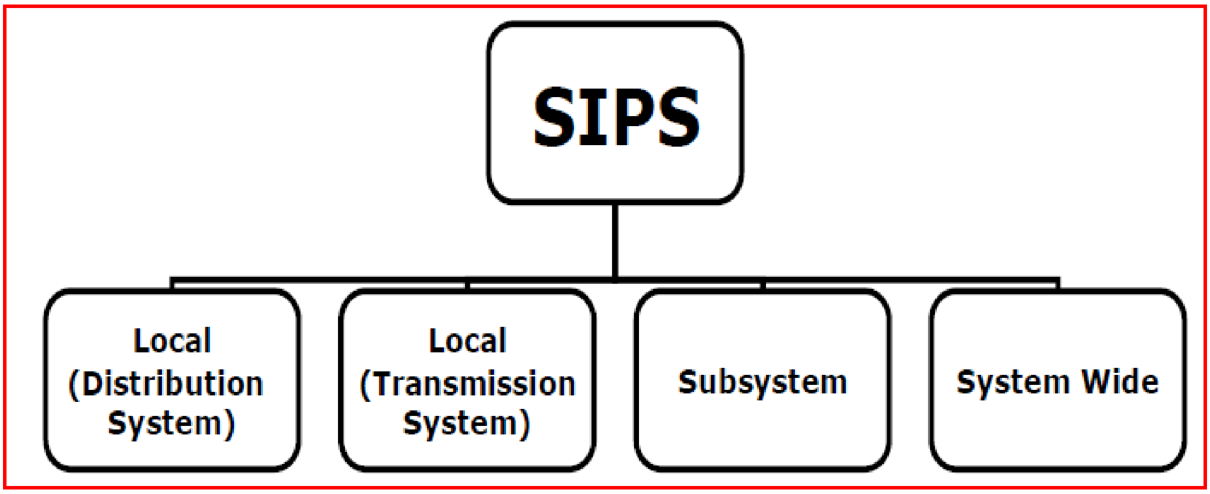

Fig. 7

Distribution and Transmission SIPS are simple in architecture and it affects a limited portion of the system. All sensing, decision-making and control devices are typically located within one distribution/transmission system. Subsystem SIPS are more complex and it involves sensing of multiple power system parameters from various locations. With the help of telecommunication systems, decision-making and logic functions are performed at one location. Corrective actions maybe performed at some remote locations. System wide SIPS are the most complex involving multi-level sensing, multi-level decision making and multi-level corrective actions. Various contingencies and outage scenarios have to be included in the logic implementation of this scheme.

SIPS can also be defined in terms of purposes and operating times. SIPS with flat architecture have both measurement and operating elements in the same location. Communication links may be needed to collect the information and make the decision and corrective actions. SIPS with hierarchical architecture may involve the use of operating nomograms, state estimation and contingency analysis. SIPS can also be defined and classified in other ways for e.g. event based, parameter based, response based or centralised or distributed or any combination of the above.

With increasing emphasis on maximizing the available network for optimum performance, there maybe a wider need of schemes like SIPS in NZ's transmission and distribution networks. The survey report can be a good source of reference for people who have interests in system integration protection schemes. Various design considerations, practices, and applications of latest technologies are illustrated in the report. The report is available online from www.pes-psrc.org

7. Protecting Distribution Feeders for Simultaneous Faults

This presentation shared the causes of simultaneous faults on distribution feeders and also discussed the overcurrent protection co-ordination problems caused by these faults. A number of operational experiences of a Mexico utility were discussed and analysed along with logic programming solutions for such faults.

Simultaneous faults can be caused due to the network topologies for e.g. multicircuit lines, switching operations and thunderstorms. Normally for a feeder fault, it is expected that the feeder breaker trips to isolate the fault. Normally, backup protection is provided by the transformer LV relay. Fault current can be higher in a transformer relay than on the faulted relays due to simultaneous faults. This higher current may operate the backup relay and unnecessarily cause the loss of supply on healthy feeders.

A typical co-ordination curve for a feeder fault is given below in Fig. 8. The curves show that the feeder relay and the transformer relay are co-ordinated well. Fig. 9 shows the curves and currents for misoperation of transformer relay for simultaneous faults involving two feeders. Note the feeder 1 and feeder 2 currents (4850 A and 1900A) for simultaneous faults in Fig. 9. Clearly, the total fault current (6750A) can trip the transformer relay before feeder 2 isolates the fault.

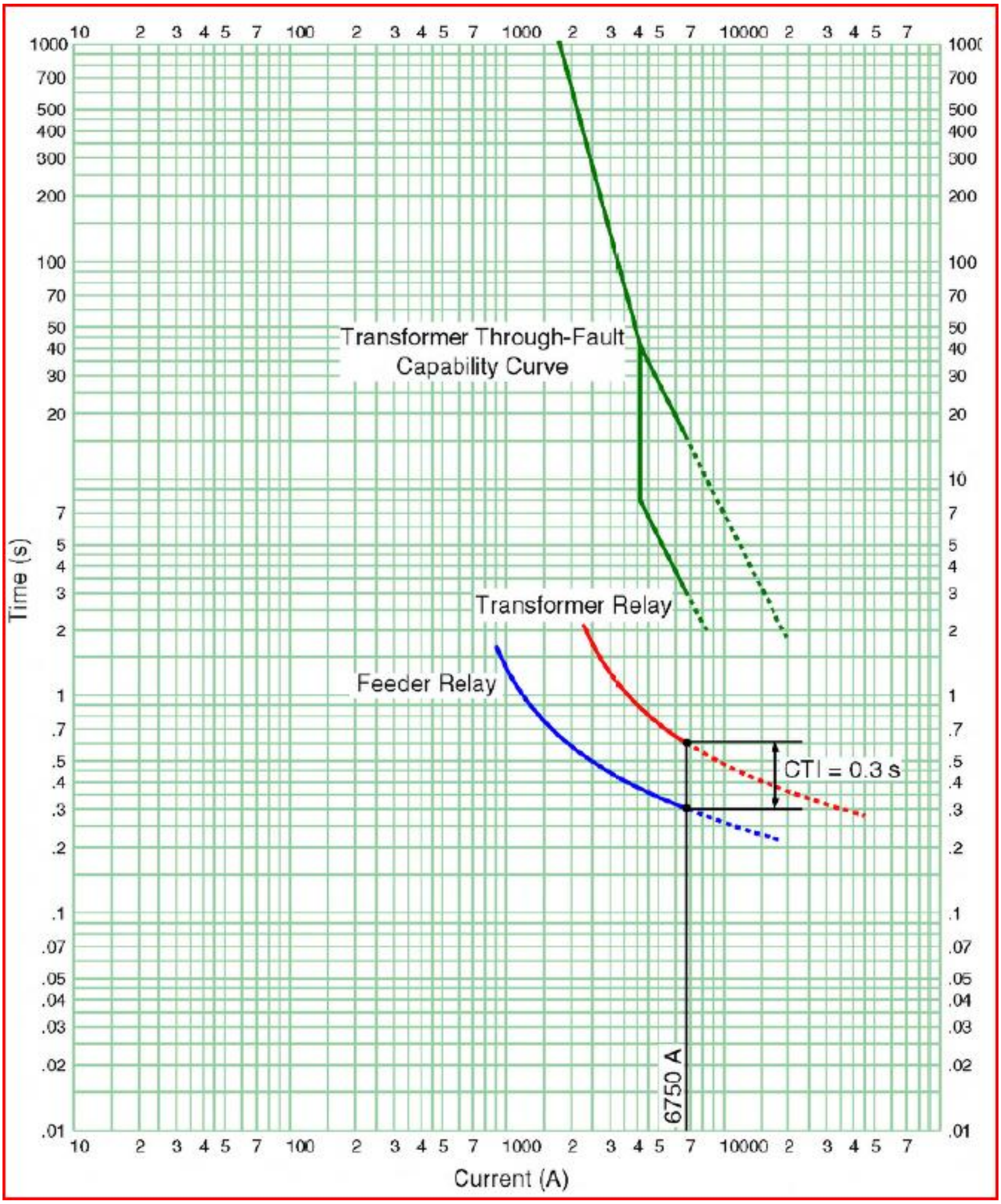

Fig. 8

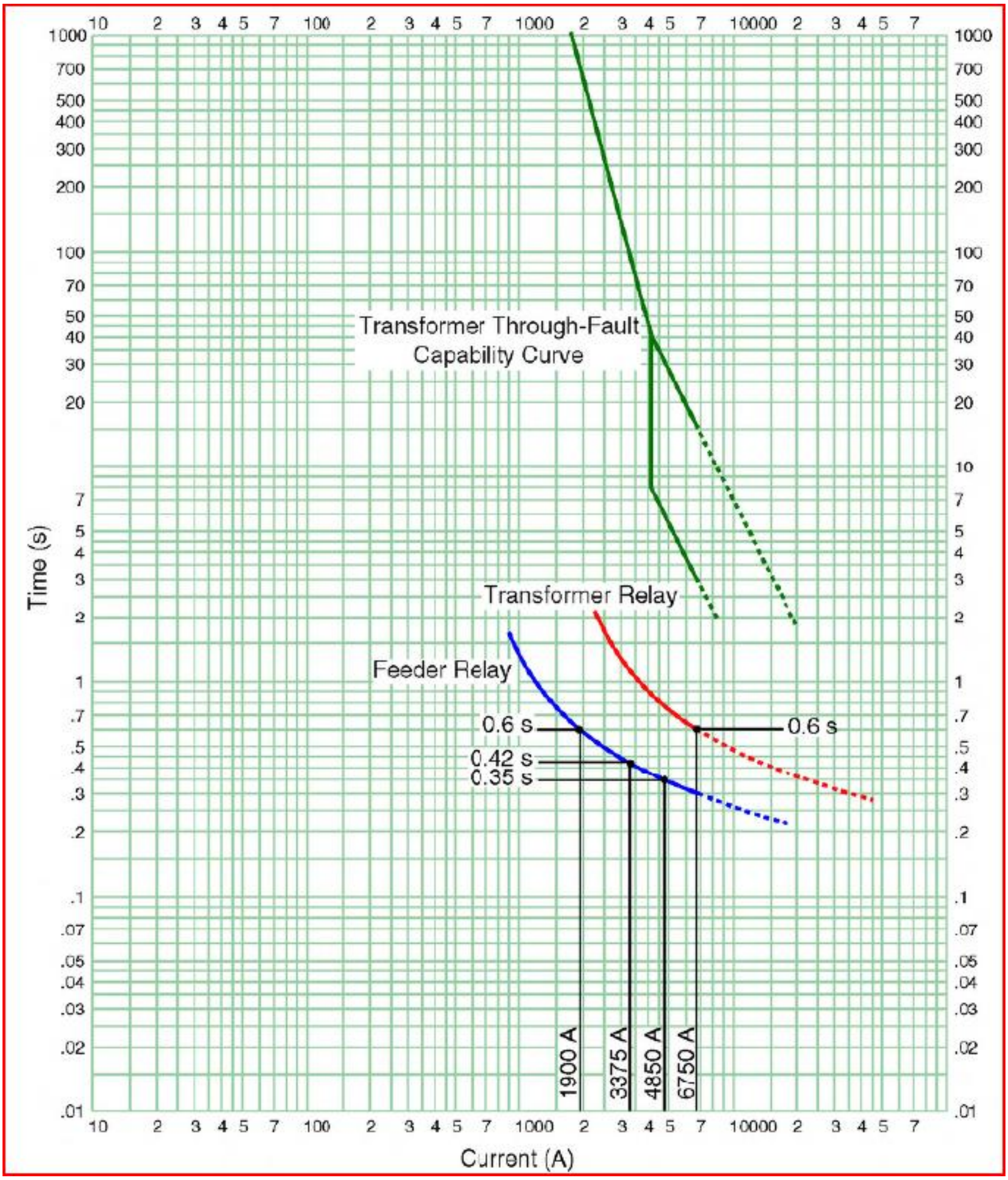

Fig.9

Protection schemes for simultaneous faults include either a centralised or distributed schemes. The simultaneous fault protection logic is programmed into either the feeder relays or the transformer relay or a logic processor. There must be communication and logic programming functions within a scheme. Fig. 10 below shows an example of a logic diagram for a centralised simultaneous fault protection scheme using direct digital relay to relay communication.

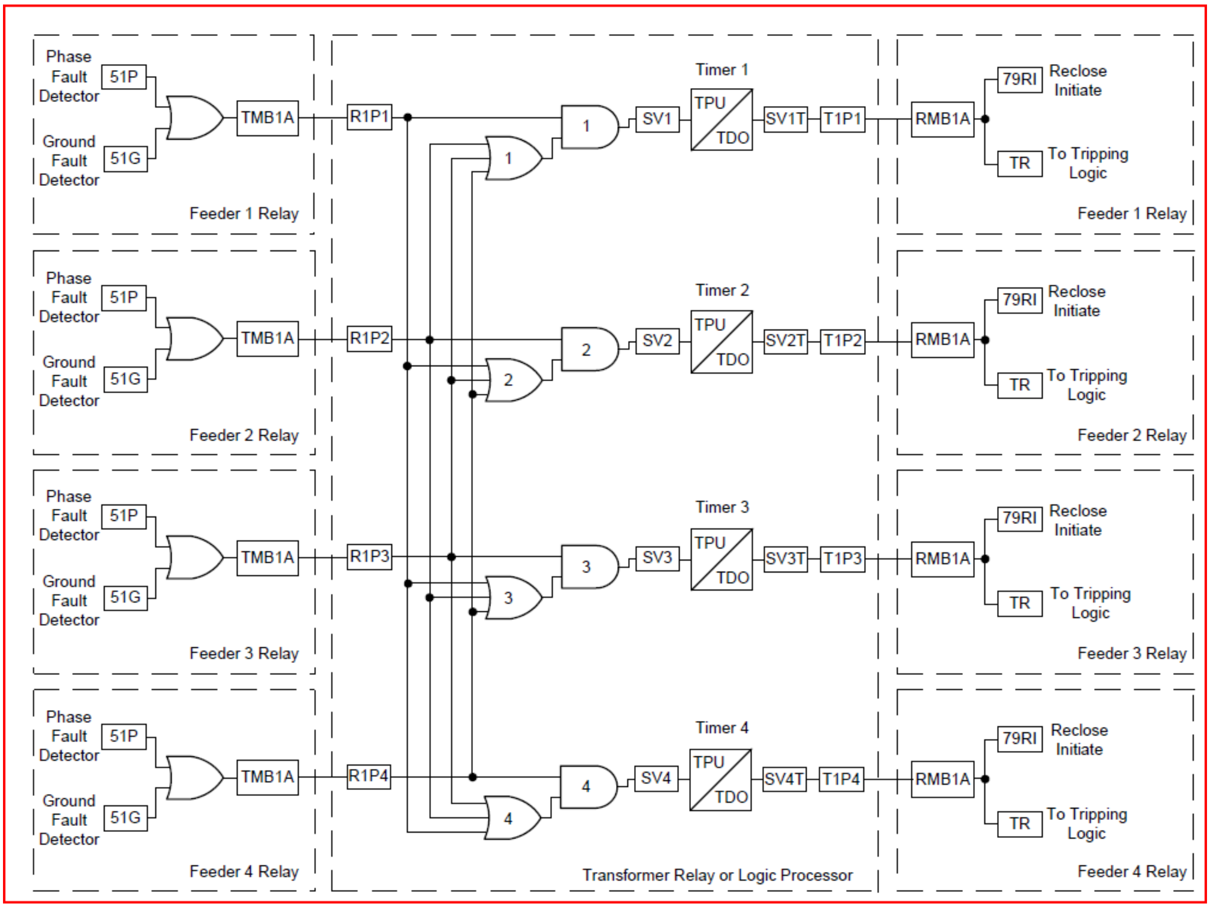

Fig. 10

Finally, the cost of implementation of simultaneous fault detection schemes outweighs the cost of interruption and the penalties associated with a complete loss of supply. Distribution utilities within NZ can implement similar logics for simultaneous faults but this will have to be realised based on the proper events analysis and settings review.

8. Cyber Security for Power Systems- A closer look at the Drivers and how to best approach the new challenges

This presentation discussed the importance and challenges of cyber security for power systems. Frequent use of Ethernet and TCP/IP based communication has increased the risk of cyber attacks by Trojans, worms, viruses etc. The paper discussed the fact that all stakeholders such as vendors, operators, and system integrators must have a collective approach to the challenges of cyber security.

The presenter discussed the various drivers for cyber security requirements. This included vendors, end users, working groups, standard bodies etc. The presentation also discussed the NERC Critical infrastructure protection (NERC CIP) regulation and cyber security associated with Smart Grid. There are currently five initiatives in this area –

1. NERC CIP
2. NIST Smart Grid
3. IEEE PES substation C10/PSRC H13
4. IEC 62351
5. IEEE 1686

Everyone realises that cyber security is an imminent risk. Cyber attacks on a facility will not only cost money or loss of supply but may also cost loss of lives. The damage can be devastating. There are many misconceptions about the cyber attacks and the solutions. Some of the misconceptions are due to the increasing use of TCP/IP protocols. Other misconceptions are related to any physical attacks on a facility. Hopefully, some of these misconceptions will be removed in the new NERC CIP regulations and also IEEE 1711. It was interesting to note that the severity of physical attacks may not be as severe as cyber attacks as the cyber attacks can make the system to run inefficiently for a very long time which can damage various assets simultaneously or within a certain time frame. Also, one substation can be used as an entry point to gain access to multiple substations and one person can shut down multiple substations.

Power system security and reliability depends on processes not on a product. It has a direct relationship with human behaviour and organisational processes. Compliance should not be the only key security and reliability solutions. Rather it can be a baseline security and reliability level. There may not be a single solution to potential cyber threats.

To the author's knowledge, cyber security is not emphasized in NZ as much as in US or in Europe. There are also no separate NZ regulation or cyber compliance requirements. Cyber security is also not vigorously considered as part of any specifications during the design of many protection schemes. There is a lot of reliance on vendors to address these issues and implement securities such as access levels etc. within the product. We may need to document the overall policy requirements in this area. NERC CIP regulation can be a good source of reference.

9. Exploring the IEEE C37.233 Guide for Power System Protection Testing

This was an important presentation for me. The presentation discussed the contents of IEEE C37.233 Guide for Power System Protection Testing. IEEE guide on protection testing covers both individual protection testing and the complex protection schemes which involve end to end testing. Data requirements and test procedures are also defined in the guide. Design tests, commissioning tests, routine maintenance tests and ongoing performance assessment tests are also focussed in the guide.

There are various types of tests mentioned in the guide and they can be either the device specific or the application oriented-

- Certification tests- There are two types of certification tests
    - Conformance tests
    - Performance tests
- Application tests
- Commissioning tests
- Maintenance tests
    - Time based maintenance tests
    - Condition based maintenance tests

A typical maintenance practice is described in the Figure 11. The figure shows a relationship between the time based maintenance, condition based maintenance and the performance based maintenance. TBM’s region 1 and 2 depends on the known reported operational condition or on results of analysis of maintenance history.

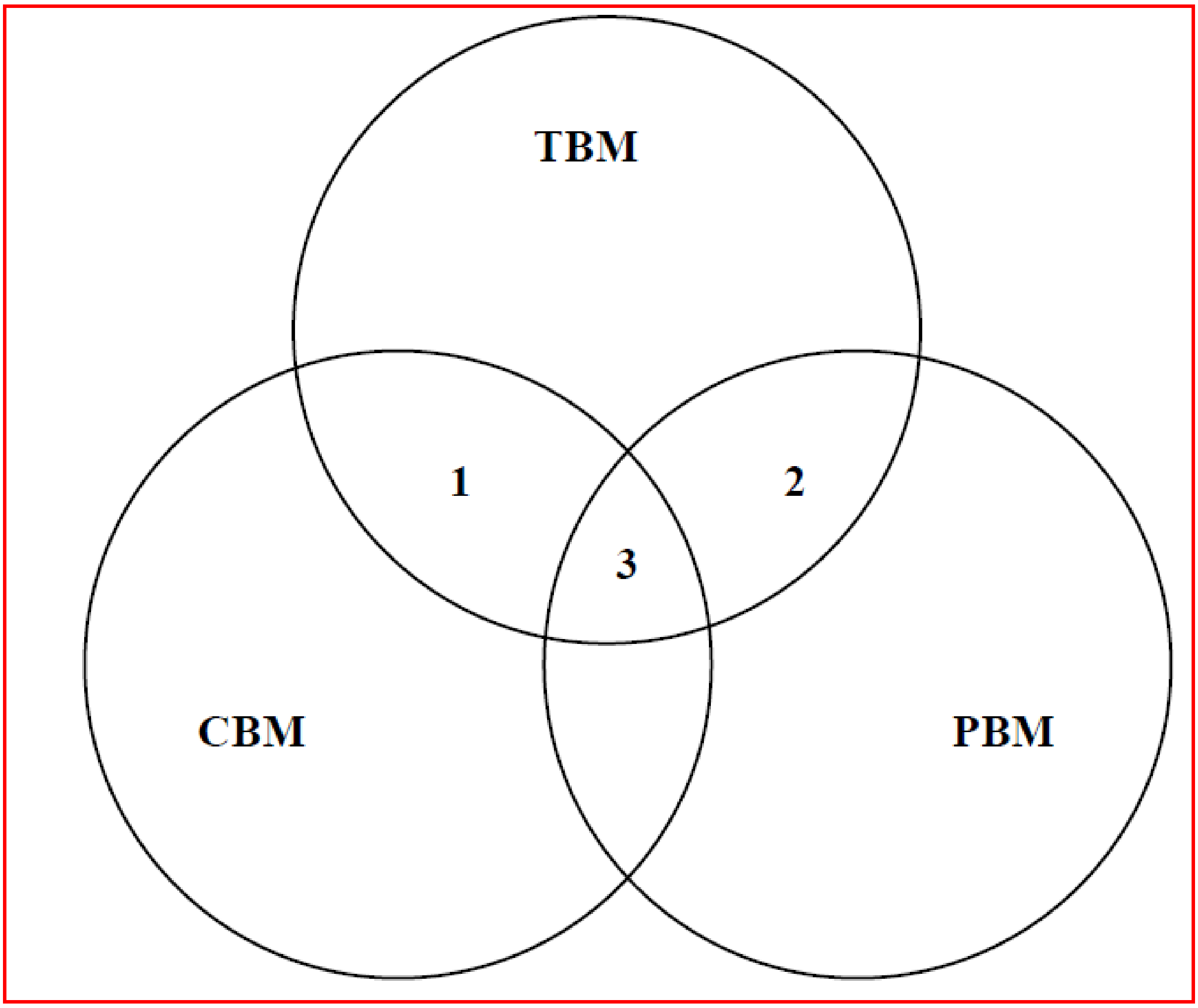

Fig. 11

IEEE guide also describes the pilot and non pilot line protection testings. All line protection may require to go through a series of certification tests, and application tests. The following line protection testings are covered in the guide–

- Non pilot protection schemes
  - Overcurent relaying
  - Distance relaying
- Pilot protection schemes
  - Directional comparison blocking and unblocking schemes
  - Direct underreaching transfer trip scheme
  - Permissive overreaching transfer trip scheme
  - Permissive underreaching transfer trip scheme
  - Phase comparison relaying scheme

  - Line current differential scheme
  - Direct transfer trip
- Automatic reclosing schemes

The guide covers testing of various other schemes and systems- transformer differential protection, distribution protection, bus protection, shunt capacitor protection, breaker failure protection, reactor protection, generator protection, trip circuit logic scheme, power line carrier testing, SIPS. Refer to: "IEEE Guide for Protection System Testing, IEEE Standard C37.233-2009, Dec. 2009 for details.

Training Tracks

A summary of the two key training tracks are given below. Other tracks are available on http://conferences.wsu.edu/wprc

1. Differential protection

BC Hydro

• Basic principles

• Bus differential

- Low impedance
- High impedance

BC Hydro

• Basic principles

• Transformer differential

o Distribution Transformers (2-winding)

o Autotransformers (3-winding)

2. Line protection

GE Digital Energy - Multilin

• Polarizing sources and Directionality

o Current

o Voltage

o Positive, Negative and Zero Sequence

GE Digital Energy - Multilin

• Basics of line protection

  o Distance

  o Directional Ground

GE Digital Energy - Multilin

• Distance and pilot schemes

  o STEP

  o POTT

  o DCB

ABB Inc

• Line differential protection

SEL Factory Tour

On the last day of the conference, SEL organised a factory tour. Interested attendees (registration required in advance) were taken to the SEL factory in Pullman. It was quite impressive to observe the state of the art technologies used in automating the relay manufacturing processes. A lot of manual work was also involved for e.g. the circuit boards had to be manually placed under the robotic machine to punch capacitors, resistors etc. After a series of manual and automated assembly of various parts, the final product would go through a series of tests before it would be packaged and shipped to the customer. It was interesting to observe the co-ordination processes between various manufacturing stages (fabrication, testing, packaging, assembly etc.).

Conclusion

37th Western Protective relay Conference was held in Spokane, USA from 17-21 Oct, 2010. The presenters discussed many protection issues, case studies and solutions. The training sessions were concurrently run. The conference is highly beneficial and I recommend it to anyone who has interest in protective relaying and power systems. The conference gave me an opportunity to network, discuss, and learn about the latest in protection systems. I also had an opportunity to visit SEL factory in Pullman. The author also thinks that we need a similar specialised conference in NZ.