Surge Protection Hall of Fame

Joseph L Koepfinger

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A 60 year Active Member of IEEE

My first involvement in AIEE/IEEE Surge Protective Devices Committee (SPDC) began very soon after I joined Duquesne Light Co (DLC) on 1 February 1949. I had been an AIEE and an IRE member since 1947 while I was a student at the University of Pittsburgh.

At the time I joined DLC as a Jr. Engineer in the Protection Group, my supervisor was George Dodds, who was a long time member of AIEE SPDC and had been a member of its protective relay subcommittee. My co-member of the Protection group of System Planning Department, William E. Marter, was a member of the AIEE Protective Devices Committee which had by then separated from the AIEE Surge Protective Devices Committee.

Mr. Dodds was a member an EEI – AIEE joint task force studying distribution circuit reliability. This was a three year project to classify and analyze the cause of outages to distribution circuits. Four electric utilities participated in the study. Fault types, fault current and outage information was to be collected on four distribution circuits per utility. About May of 1949, I was given the task, along with a student engineer, to ride the four DLC circuits. Our task was to verify the location of transformers, switches, protective device, circuit configurations and conductor material, conductor sizes and covering. It was a great learning experience in the learned design and operation of a distribution system. From this experience I found there were many streets that existed only on the circuit maps but not in the real world. We call them paper streets. The local operating people were well aware of these nuisances.

Once this task was completed, we entered the data collection phase. Since Mr. Dodds was the chair of the task force he had the thankless task of collecting outage information and developing a method to analyze all of the data from all 16 circuits as was the case, at that time, a newly minted engineer received the privilege of being assigned this onerous task. To get uniform data, it was necessary to develop a data sheet which were to be completed by the trouble man (this was before neutral gender became popular) in each participating company for every known outage to the circuits involved in the study. This involved both sustained outages as well as momentary outages for a period of three years. As one can imagine, this involved a massive

amount of data to be tabulated, summarized and analyzed at a time before digital computers were available.

The problem was solved by the developed a manual punch card system. It had data point encoded around the peripheral of 4"X6"card. Each data point was represented by a hole. There were at least 50 possible data points for each outage. This allowed the outage information that the trouble man recorded on the datasheets to be manually transferred to the punch cards by using a conductor's punch to snip out part of the hole associated with the appropriate data point. By using something akin to a netting needle it was possible to insert the needle into the holes in a stack of card and remove all of those for which the object of the search did not apply. What was left in the stack of card where those items of the desired items of the search.

Once the results were analyzed a report had to be prepared. During this period Mr. Dodds received a promotion to the office of the Vice President of Operations at Duquesne Light Co. As we worked on the report he had his secretary join us to take dictation. This turned out to be a great benefit to me in many ways, one being that the secretary ultimately became my wife in 1955. Since then she has been involved with me in many ways in my work in IEEE SPDC and many other standards activities all while busy raising six children. The data was final analyzed in 1953 and a joint EEI – AIEE paper was published in 1954.

By 1955, I became involved with my first SPDC working group when I became a member of the working group to revise AIEE Standard 32 "Neutral Grounding Devices". There was a concern then that neutral grounding devices did not have appropriate continuous as well as short time ratings. Lacking was the bases for the bases of establishing such ratings for grounding transformers and neutral reactors. The working group, after about a year of discussion, developed a proposed rational.

About this same time, loading guides were being developed for power transformers that took into consideration the loss of life that would be experienced if a transformer was occasionally operated above its nominal design load. This method was based on ageing characteristic of the insulation system as it related to temperature using the Arrhenius Rule It was felt that, for grounding transformers and reactors, it would be logical to use a similar approach to establish their short time ratings as well as their continuous current ratings. A general design criterion for a power transformer was an assumption that it would see a certain number of faults during its lifetime. A life time was generally assumed to be 40 years. Some loss of life was assigned to normal operation. The amount of remaining life was distributed between expected fault current exposure and fault current duration and time. For faults a 1% loss of life per phase was assigned to the transformer and a similar value assigned for overloads.

Since a grounding transformer or a neutral grounding reactor would see phase-to-ground faults on all of the phases, it was decided that it would be sufficiently conservative use a factor of 3 times number of faults expected to be seen by a power transformer during is life cycle This information was used to derive the continuous current ratings that were given in AIEE 32 around 1958. Prior to establishing these values, a member of the working group, associated with General Electric Co, produced an AIEE Conference Paper. The paper was prepared to solicit comments from industry about this

approach. The paper did not receive any negative discussion, thus the proposed continuous current ratings as well as the short time ratings were included in the next revision of the Standard.

Sometime in the early 60's, I served two years as the chair of SPDC. During that time period, I was able to start the low voltage surge protective device activity in SPDC. This resulted in the development of standard C62.31 "Test Specifications for Gas Tubes", today this would be referred to as surge protective device components. Before I became the chair I served as Secretary for the Committee. William Price, a distinguished member suggested that we needed to provide an opportunity for the members to interact in a more relaxed atmosphere and suggested that we have a hospitality room. So, I was selected to make this happen. This became real popular with the members. Many issues that could not be settled in a working group found solutions during this evening social event. We began to see more spouse attend the meetings. Over time many long term friendships were created among the members.

As the chair of the SPDC, I had to attend the meetings of the PES Technical Council. The next thing I knew, I was asked to replace Joe Fitzgerald of Cleveland Electric Illuminating Company as the PES Standards Coordinator. I did this task for about three or four years, then in 1971 I was appointed to the IEEE Standards Board by PES. By 1974, I was appointed Chair of the IEEE Standards Board and served two one year terms. Again in 1976, I was requested to be President of the Standards Board and served another two consecutive one year terms beginning in 1977. In 1976, the Standard Board was given a non-voting position on the Board of Directors. During these last two terms on the IEEE Standards Board I also served as a member of the Board of Directors of the Institute. While I was President of the Standards Board I was instrumental in getting two SPDC members, David Phelps and Ed Cohn nominated to the Standards Board.

In 1976, David Phelps approached me and asked if I would give consideration to assuming his duties as Chair of C62 and those of the US Technical Advisor for IEC Technical Committee 37 (TC 37) the next year. At the time, I thought this would be an opportunity to learn more about IEC. I did not know then that I would again be chairing the IEEE Standards Board. At this same time in the 1977-1979 period I was managing a Protection and Communication Group at DLC, serving as a member School Board in my community, trying to met my commitment to IEEE Standard Board, ANS C62, US National Standard Committee of the IEC and keep up my committee activities in SPDC, the IEEE Power System Relay Committee (PSRC), Pennsylvania Electric Association (PEA) and represent my company in East Central Area Reliability (ECAR).

Because of all of these commitments, I dropped my IEEE Power System Relay Committee activities, where I was member since 1963. It was in this committee that I chaired a working group that developed the first standard on surge protection, C37.90.1, Surge Withstand Capability (SWC) Tests for Protective Relays, 1974.

ACS C62 was originally created to coordinate the development of standards for lightning arresters. Each of the organizations, Electric Light & Power (EL&P) part of Edison Electric Institute,(EEI), National Electric Manufacturers Association (NEMA and IEEE. Each of these bodies had their own standards for lightning

arresters. The IEEE Standard was called IEEE 28 and NEMA's was LA 1.

C62 was the vehicle used by IEEE to process their SPDC standards to be recognized as American National Standards. This arrangement was by an agreement between them and NEMA. EEI did not participate in this agreement as they had decided with the formation of C62 they did not need to continue to write standards for lightning arresters. In 1982 EEI decided to completely withdraw from developing any standards due to a liability concern.

According to the agreement, the roll of IEEE was to write the applications and test standards. When test value or performance values were to be included in an IEEE Standard, they were to be provided by NEMA. A similar process was contained in the agreement between IEEE Switchgear Committee and C37 and between IEEE Transformer Committee and C 57.

By 2002, IEEE had become an accredited standard organization of ANSI and as such really did not see any advantage of processing its standards relating to switchgear, transformers or surge protective devices via the Accredited Standards Committees process. Thus, it withdrew from the agreement. In doing so, it has complicated the standard development process for surge protective devices, by it very open voting process it permits other than those organization involved in the manufacturer, application and use of surge protective devices to vote on a national standard.

C62 still exists to provide a forum for the discussion of low-voltage surge protective device activities for parties other than IEEE. I have held the chair of this committee since 1978. It Low voltage subcommittee is monitoring International Standards

In 1996, I took over the position of Secretary of IEC TC 37 from Phil Bogner and held that position until 2003 when, because of an illness, I relinquished that duty to Michael Comber. With the formation in IEC of SC 37A for low-voltage surge protective device standards, I became the US Technical Advisor (TA) for it. Later when IEC formed SC 37B, I also assumed the duty of the US TA for it. I still hold these positions in addition to participating in SC 37A working groups as a US Expert.

My other IEC involvement is as the US TA for TC 8 "Electrical Systems" and serving as the USNC member of the IEC Sector Board 1.

All of these activities have me an opportunity to remain active in the field of electric power engineering even after I retired from DLC in 2000 after 51 years of service. I was given the opportunity to serve DLC as a consultant for another year. Then, after a year off I was requested to assist at Beaver Valley Nuclear Power Station to review the protection settings for two nuclear units that were now owned and operated by FENCO. Now, as distinguished lecturer for IEEE PES, i give lectures in the United States and many foreign countries. My latest venture is being part of a new PES lecture series called Plain Talk.

During my long career, I have written many technical papers on relay protection, power system grounding and surge protection. I am a Fellow of the Institute and have received many awards including the Steinmetz Award and the IEEE PES Excellence In Power Distribution Award. I was an ABET reviewer for eight years. I've served as an industrial advisor to Penn State Department of Nuclear Engineering,

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Louisiana Southwest Department of Electric Engineer, West Virginia University Department of Electrical Engineering and the Carnegie Mellon School of Architecture Advanced Building Integrated System Concept. I am a member WVU Academy of the Lane Department of Computer Science and Electrical Engineering.

During my active working career at Duquesne Light Company served on the Board of Maglev Inc., a Pittsburgh organization of Industry, Government and Labor who initially hoped to build a demonstration high speed magnetic levitation system between Pittsburgh International Airport and downtown Pittsburgh that would reduce travel time from 35 – 45 minutes to 7 minutes.

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Joe and Genevieve Koepfinger Oct 2004 Stockholm Sweden