IEEE TRANSFORMERS COMMITTEE

MINUTES OF OCTOBER 27, 1982

PHILADELPHIA, PA

MINUTES OF THE IEEE
TRANSFORMERS COMMITTEE
OCTOBER 27, 1982

MARCH 28, 1983

IEEE TRANSFORMERS COMMITTEE

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MEMBERS OR REPRESENTATIVES PRESENT

W. J. McNutt, Chairman
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J. C. Arnold
R. Bancroft
P. L. Bellaschi
S. Bennon
B. S. Bernstein
J. V. Bonucchi
J. D. Borst
C. V. Brown
F. J. Brutt
D. F. Buchanan
G. N Bull
E.J. Cham
E. Chitwood
F. W. Cook, Sr.
J. Corkran
J. C. Dutton
J. K. Easley
J. A. Ebert
C. G. Evans
W. R. Farber
H. G. Fischer
S. L. Foster
H. E. Gabel, Jr.
C. M. Gardam
J. Gerth
L. N. Gifford
A. W. Goldman
J. F. Goodavish
J. C. Gorub
W. F. Griffard
R. L. Grubb
J. H. Harlow
F. W. Heinrichs
K. R. Highton
P. J. Hoefler
C. C. Honey
E. J. Huber
F. Huber, Jr.
G. W. Iliff
R. G. Jacobsen
A. J. Jonnatti
C. P. Kappeler
O. Keller
J. J. Kelly
W. N. Kennedy
R. C. Kieren
E. Koenig
J. J. Kunes
J. Larkso
W. Lampe
H. F. Light
L. W. Long
M. L. Manning
J. W. Matthews
L. S. McCormick
C. J. McMillen
S. P. Mehta
N. J. Melton
C. K. Miller
C. Millian
R. E. Minkwitz, Sr.
C. E. Mitchell
H. P. Moser
W. H. Mutschler
L. Nicholas
E. T. Norton
R. A. Olsson
H. A. Pearce
D. Perco
L. R. Smith
W. W. Stein
L. R. Stensland
D. Takach
A. L. Tanton
V. Thenappan
R. C. Thomas
F. W. Thomason
D. E. Truax
R. E. Uptegraff, Jr.
L. B. Wagenaar
T. L. Walters
S. A. Wiencek
R. J. Whearty
W. E. Wrenn
A. C. Wurdack
O. R. Compton
H. R. Moore

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MEMBERS ABSENT

L. C. Aicher
J. Alacchi
B. F. Allen
R. Allustiarti
H. W. Anderl
S. J. Antalis
E. H. Arjeski
A. E. Baker
D. A. Barnard
L. Baranowski
G. M. Bell
S. Benko
J. J. Bergeron
A. Bimbiris
J. W. Binius
G. H. Bowers
H. R. Braunstein
T. Brown
J. H. Brunke
K. A. Bryan
J. G. Bryant
G. Bryant
J. P. Burkhart
R. A. Burns
W. J. Carter
D. J. Cash
E. E. Chartier
O. O. Chew
D. O. Craghead
D. W. Crofts
M. G. Daniels
R. C. Degeneff
K. W. Doughty
D. H. Douglas
J. D. Douglas
D. A. Duckett
E. C. Edwards
R. L. Ensign
P. P. Falkowski
J. Foldi
J. A. Forster
R. H. Frazer
R. M. Frey
M. Frydman
G. L. Gaibrois
J. H. Galbraith
D. A. Gillies
J. Gonzalez
R. F. Goodman
C. H. Griffin
J. W. Grimes
G. Gruehbaum
R. L. Grunert
G. Gunnels
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G. Hall
R. S. Hamilton
T. K. Hawkins
D. E. Hazelton
W. Henning
J. J. Herrera
A. Higby
M. C. Hillman
R. H. Hollister
E. L. Hook
M. Hudis
C. Hurty
E. T. Jauch
D. C. Johnson
F. L. Johnson
N. Johnson
R. P. Johnston
W. D. Jordan
C. Kaiser
H. M. Kalet
L. A. Kenoyer
R. F. Kerwin
L. A. Kilar
R. Kimball
A. D. Kline
W. A. Kofke
J. G. Lackey
J. Lapp
T. S. Lauber
J. Lazzara
R. E. Liebich
G. Lindland
G. Lindsay
K. R. Linsley
T. G. Lipscomb
R. Little
R. I. Lowe
R. Marek
H. B. Margolis
R. J. Mayschak
G. G. McCrae
L. A. Merrifield
G. P. Michel
L. D. Miller
W. J. H. Moore
E. L. Morrison
V. R. Mulhall
R. J. Musil
D. Natrass
J. J. Nay
P. Niemiec
S. D. Northrup
T. H. Orrock
J. H. Ottevangers
B. K. Paten
R. Pearson
W. W. Pendleton
J. D. Phillips
J. L. Puri
G. J. Reitter
A. L. Rickley
D. A. Roach
C. A. Robbins
H. Robin
J. Rodden
T. O. Rouse
P. R. Russman, Jr.
F. I. Samuelsson
L. J. Savio
R. L. Schmid
E. W. Schmunk
D. M. Shah
D. E. Shefka
R. L. Simpson
T. Singh
B. E. Smith
B. Stanleigh
R. B. Stetson
F. R. Stockum
L. Swenson
B. Teer
J. A. Thompson
L. K. Thompson
M. A. Thompson
T. P. Traub
E. F. Troy
G. Vaillancourt
W. E. Vannah
S. G. Vargo
R. A. Veitch
F. Vobel
J. P. Vora
R. Wagner
J. W. Walton
R. D. Welsh
A. Wilks
C. R. Willmore
D. Wright
E. J. Yasuda
C. S. Bill Yung
L. Zachrison

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GUESTS

W. Boettgier
D. Fallon
R. E. Lee
J. W. McGill
J. L. Moon
J. Konz
R. W. Simpson, Jr.
P. Singh
C. W. Snyder
C. H. White

Other new liaison and committee assignments include the following:

Liaison to IEEE W.G. 70.1 - "Gas Insulated Substations" - O. R. Compton

Liaison to ANSI C57.21
Chairman W.G. on Shunt Reactors — J. W. McGill

PES Awards Committee
PES Recognition Committee — L. W. Long

III. By action of the Administrative Subcommittee, five (5) new members were invited to join the Transformers Committee:

E. Chitwood- TVA
J. Ebert - RTE/ASEA
W. Lampe - ASEA
L. Wagenaar - AEP

Dean Yannucci will be distributing updated membership lists with the minutes of this meeting and he has undertaken to put our lists into a computer program which will include all Subcommittee and Working Group assignments.

IV. Future Transformer Committee Meetings

Next Meeting:

April 10-13, 1983 — Peachtree Plaza, Atlanta, GA, Host: G. Evans

Fall, 1983 Detroit Nov 6-9
Spring, 1984 Vancouver April 1-4

Details for Fall, 1984:

October 15-17, 1984 — Park Plaza Hotel, Boston, MA, Host: Minkwitz

April, 1985 - St. Louis

Opening for Spring, 1985
West of the Mississippi

Fall, 1985 — Toronta, Canada, Host: R. Vietch

Spring, 1986 - Little Rock, Ark

V. Other Business

Plans are for another Transformer Tutorial. An organizer has been selected and will be announced when he has the approval of his management. The Tutorial Text is published by IEEE and is generally presented at a Winter and Summer Power Meeting.

One may have noted that an article of activities of the Transformers Committee appeared in a recent issue of the PES Review.

1.0 Chairman's Remarks and Announcements

The chairman convened the meeting at 8:00 a.m. and welcomed members and guests in attendance. A special thanks was given to Mr. Robert Whearty for being host and providing the excellent arrangements. The attendance for the meeting was announced by Mr. Whearty as 150 registered members and guests.

2.0 Approval of Minutes March 31, 1982

The minutes were accepted and approved as written.

3.0 Report of the Administrative Subcommittee - W. J. McNutt

The Administrative Subcommittee met at 7:00 p.m. on Monday evening, October 25, 1982. Reportable activities at that meeting include the following:

I. Committee & Subcommittee Officers

Effective Jan. 1, 1983, the new Transformers Committee officers will be:

Chairman:	L. J. Savio
Vice-Chairman:	D. A. Yannucci
Secretary:	H. F. Light*

*Pending final confirmation from Niagara Mohawk Power Co. management.

Effective at this meeting, Mr. L. B. Wagenaar has replaced J. K. Easley as Chairman of the Bushings Subcommittee. John was the first and only chairman of the Bushings Subcommittee and he steps down now as the result of his retirement from the General Electric Co. We all extend our heartfelt thanks to John for his dedicated service to the Transformers Committee, and we wish the best of luck to Loren as he assumes the chairmanship.

Ron Little of Washington Water Power Co. was also announced as the new Chairman of the West Coast Subcommittee replacing Roger Jacobsen.

II. Liaison Activities

The following reports were discussed:

PES Standards Coordinating Committee - L. J. Savio
TOD Activities - W. J. McNutt
ANSI Standards Status - J. C. Dutton
Standards Project Status - L. R. Smith

VI. PES Standards Coordinating Committee - L. J. Savio

A PES Standards Coordinating Meeting was held at the Summer Power Meeting which I did not attend. I have not received minutes of the meeting. However, other activity is highlighted below:

1) The SCC has advised the IEEE Standards that it recommends no SCC coordinating activity be required for re-affirmation or withdrawal of standards documents.

2) Since January 1, 1982 I have reviewed 16 requests for coordination and we have accepted three for coordination, i.e.

   a) Guide for Containment of Oil Spills in Substations.

   b) Design Tests for Distribution Surge Arresters

   c) Performance and Testing Specification of HVDC System.

3) We have submitted four project requests to the Standards Board since January 1, 1982.

VII. TOD Activities - W. J. McNutt

TOD met on Monday evening, July 19, 1982 at the Summer Power Meeting in San Francisco. Items of note are as follows:

1. TOD endorsed the proposed PES reorganization which has been thoroughly communicated throughout the Society recently. Subsequently, at the PES Council meeting on July 22, that body also approved it with minor modifications.

2. A new TOD Publications Committee was approved to deal with policy matters regarding technical paper publication, including allotment of numbers of papers, page limits, page charges, etc. The Technical Paper Coordinator for each Technical Committee would serve on the Publications Committee. Dean Yannucci would be our committee member for 1983-1984.

   Prior to the formation of the new Publications Committee, the PES Publications Department had already made the following decisions:

   (a) 220 papers for 1983 WPM.
   (b) Authors required to pay $80 per page beyond page limit.
   (c) External subscription charge for transactions will be $180.

VII. TOD Activities - W. J. McNutt (Continued)

3. It was voted to abolish the practice of "Blind Peer Review" of technical papers. It will no longer be necessary to remove authors' names before distributing papers for review.

4. The Substations Committee will sponsor a session on "PCB's - Technical Aspects" at the 1983 Summer Power Meeting. The Power System Engineering Committee will develop a technical information paper on the impact of PCB regulations.

5. The IEEE Laboratory Accreditation Program For Nuclear Testing Laboratories has been put on "Hold" by the IEEE Board of Directors. Staff has been instructed to enter into no promotional activities and spend no money. An Ad Hoc committee will study the matter, including the NRC position.

6. TOD approved implementation of a Report of the Task Force on Advanced Electrotechnology Applications to Nuclear Plants. The report will be presented at the 1983 WPM. The principally affected technical committees are Nuclear Power Engineering Committee and Power Generation Committee. Each has been asked to prepare an implementation schedule.

7. A TOD Task Force has prepared a position paper on "Safety and Interconnected Operation of Dispersed Storage and Generation Equipment" which TOD voted to publish.

3.1 Audible Sound and Vibration - R. E. Liebich

We had eight (8) members and six (6) guests attending the meeting and one of the guests expressed interest in becoming a member. The chairman read the minutes of the last meeting and were approved as read. A revised Subcommittee membership list was distributed by the chairman dated March 31, 1982. The chairman indicated that two persons not attending have requested invitations for membership. It is anticipated that the Subcommittee will number approximately 18 persons as of the next meeting and that is an increase of 3 after adjustments for attendance have been made.

The chairman announced his intent to establish a new Working Group, WG4, for attention to the environmental impacts of transformer noise. This would include such topics as techniques for calculating the audibility of core tones in the presence of broad band noise and estimating community reactions to transformer noise. We will be extending an invitation to Dr. John Molino of Wiley Laboratories in Arlington, Virginia to accept chairmanship of this Working Group.

3.1 Audible Sound and Vibration - R. E. Liebich (Con't.)

The chairman reported for Mr. Len Swenson of Working Group 2 that to date he has received nine responses from utilities, 2 from manufacturers and 1 from a consultant to the questionnaire that he distributed at the March meeting. The majority of these indicated they are using NEMA PR1 sound levels as their reference for prediction of far field sound levels.

Mr. Cliff Millian commented that he had not seen the questionnaire and it was generally agreed that a new effort of distributing the questionnaire to a truly representative number of utilities is warranted.

The chairman and Jack McGill identified at least three models for noise prediction that have been published in studies and papers within the last five years based upon actual performance measured at operating substations.

The chairman reported for Mr. Collin Gordan of Working Group 3. His recommendation that standards project P523 be withdrawn because the original objectives of that project have been met by the publication of 1981 of the ESEERCO report ER914 titled "Power Transformer Noise Abatement."

A motion was made, seconded, and passed by unanimous vote of the members present to withdraw E523. Mr. Lewis Nicholas made a motion that the Subcommittee endorse adoption of a plus 1 db tolerance for determination of compliance NEMA sound levels as is done in National Standard of Canada CAN3C88M79 Table 10. After considerable discussion among most of the members present, the motion was not seconded.

The chairman distributed copies of a 1959 AIEE paper by S. I. Ingram titled "Planning Substations to Avoid Noise Complaints" which was provided by Siemens-Allis, Inc. as an example of the clearly written presentation of a technique for estimating the audibility of core tones under the presence of broad band noise. He also distributed copies of the contents pages of IEEE Standard 85 titled "IEEE Test Procedure for Airborne Sound Measurements on Rotating Electric Machinery" which includes methods for calculating from sound pressure measurements the acoustic power levels of rotating electrical machines. He reveiwed some of the recently developed measuring techniques being used by manufacturers of large mechanical systems and diesel engines as well as measurement geometries adopted for use in the ASME PTC36 Standard concerned with the measurement of large extended sources, such as turbine generator systems.

The chairman ended the meeting at after making a general appeal to the members to submit to the appropriate Working Group chairman proposals for specific Working Group tasks that would be a foundation for future new IEEE documentation; for example, not only Standards but recommended practices, guides and trial use specifications.

3.1 Audible Sound and Vibration - R. E. Liebich (Con't.)

Those that want to inquire about the ESEERCO sound report should write to:

Empire State Electric Energy Research Co.
1271 Ave. of the Americal
Suite 3950
New York, NY 10020

3.2 Bushing Subcommittee - J. K. Easley

Since my retirement in July, I have come to realize that the lack of a corporate sponsor creates problems for a Subcommittee Chairman. As a result of Bill McNutt's persuasive powers, L. B. Wagenaar of American Electric Power has agreed to succeed me as Chairman of the Bushing Subcommittee.

I have known Loren for many years as a strong competitor. Because of conflicting corporate economic goals, we have often found ourselves on opposite sides of NEMA negotiations. I have always found Loren to be an honorable and dependable opponent who competes fairly and squarely. I can't think of anyone I would rather see as your new Chairman. Surely, the Bushing Subcommittee is in good hands.

The working group on Bushings to Operate in Gas Insulated Substations met Monday. The scope was set to concentrate on the bushings at the interface between the transformer and the gas insulated bus. The two most difficult problems were identified and reviewed. These are pressure testing and thermal considerations. Homework projects were assigned which will enable the working group to begin the task of compiling a first draft.

The Subcommittee met Tuesday with nine members and seven guests present. The second draft of a revision of the basic bushing standard ANSI C76.1-1976 was reviewed in detail. Many minor improvements were suggested but no major conflicts emerged. So, this document is essentially ready for balloting within the Subcommittee.

3.2 Bushing Subcommittee - J. K. Easley (Con't.)

As a follow up on the two projects that are of the most interest to the Transformers Committee, Mr. Bertram Stanleigh has advised me by phone that both the Bushing Loading Guide, Project P757 and the revision of ANSI C76.2-1977, Project P24 will be submitted to the membership of ANSI Committee C76 for letter ballot before the end of November. I am sure that Fred Huber, our liaison to the Standards Office, will report progress on these two projects at the spring meeting.

It has indeed been a pleasure to serve as Chairman of the Bushing Subcommittee. My present plan is to remain on the Committee but in a less demanding role.

3.3 Dielectric Test Subcommittee - L. S. McCormick

The subcommittee met at 8:00 A.M. with 34 members and 13 guests in attendance. With the addition of two new members, Mr. G. Vaillancourt of IREQ and Mr. L. B. Wagenaar of AEP, the membership now stands at 62.

The minutes of the previous meeting in Los Angeles were approved as published.

The various working groups reported on their activities as follows:

WORKING GROUP ON REVISION OF DIELECTRIC TESTS
G. W. Iliff, Chairman

The trial use document covering dielectric testing of transformers rated at 115 kV through 230 kV, ANSI C57.12.14 will be in print very soon. The galley proofs have been reviewed and returned to the publisher.

The task force on combining the trial use doucment, 262.b, and the dielectric test requirements of ANSI C57.12.00 has balloted draft one of this document and reached tentative agreement on a draft two. Items which were discussed and on which agreement was reached and not yet reported on previously were:

3.3 Dielectric Test Subcommittee - L. S. McCormick (Con't.)

1. Dielectric tests for 1100 kV will not be included in the table of test levels.

2. The following BILs will be removed as recommendation values:

   a. 825 kV for 345 kV systems
   b. 1050 kV for 230 kV systems

3. During switching surge tests, connections should be used that result in 1.5 p.u. voltage appearing phase-to-phase.

4. Terminations for other windings during impulse testing were modified slightly per recommendations from the surge protective device committee.

Draft two of this document will be balloted next in the Task Force, Working Group and Subcommittee.

It was reported that NEMA has added the question of external clearances at 345 kV and above to their agenda and will discuss this at their next meeting. We will monitor their progress and report back at the next meeting.

The Task Force on Revision of Dielectric Tests of Shunt Reactors, C57.21 has been reorganized with Bill Kennedy as Chairman and includes R. Musil, C. Honey, O. Keller and S. Foster.

A group was organized to review the IEEE Standard 4 with respect to the response time of the measuring circuits used during impulse testing.

REVISION OF DIELECTRIC TESTING OF DISTRIBUTION TRANSFORMERS

W. R. Farber, Chairman

During their meeting they covered three items:

1. Phase-to-phase tests

   The Working Group has successfully balloted a proposal to revise Table 6 of ANSI C57.12.00. This revision will require a phase-to-phase test of two times system voltage for distribution transformers. They plan to ballot the subcommittee before the next meeting.

3.3 Dielectric Test Subcommittee - L. S. McCormick (Con't.)

2. The Task Force assigned to develop routine test procedures for impulse testing the HV windings of distribution transformers reported that they intend to work as follows:

   a. Make the impulse testing of HV windings a routine test

   b. Develop a test code to define the tests

   c. Prepare a test guide

3. The Working Group also heard a report by C. McMillen on a paper he presented at the Winter Power Meeting. This paper covered partial results of an EPRI project to identify possible causes of anomalous failures of distribution transformers. One possible cause that this work has identified is current surges entering the low voltage terminals and transferring to the HV windings where failure occurs.

WORKING GROUP FOR DIELECTRIC TESTS OF HVDC STRESSED TRANSFORMERS
W. N. Kennedy

Due to the absence of the Chairman, C. Hurty, Bill Kennedy chaired this session and reported they had discussed proposals on polarity reversal tests. These proposals were related to the test levels, 1.25 instead of 1.1 and to the number of reversals, two instead of one.

They also agreed to reduce the time of partial discharge measurement from the last twenty minutes of the one hour dc test to the last ten minutes.

3.3 Dielectric Test Subcommittee - L. S. McCormick (Con't.)

WORKING GROUP ON PARTIAL DISCHARGE TESTS
H. R. Moore

Consider measuring both pC and μV in spec - contact GV by July 1

G. Vaillancourt, Chairman of the Task Force on Measurement of Apparent Charge reported data taken on the pc/μV ratio of a number of transformers. This data confirmed that the ratio increases as the transformer size increases, and that there is a wide dispersion in the data. This task force will undertake to accomplish the following before the spring meeting:

1. Determine recommendations for apparent charge circuits, including the calibrator, before 1/1/83.

2. Draft a specification for apparent charge measurements, including recommended procedures by 1/1/83.

3. Submit the above, along with a plan for making comparative pc/μV measurements, to different companies so that additional data can be collected.

4. Present the available data at the spring meeting and start to finalize a guide for measuring apparent charge.

Mr. E. Norton is taking over as Chairman of the Task Force on Acoustic Detection. They plan to prepare a guide for factory and field detection of partial discharges utilizing acoustic techniques.

TASK FORCE ON RECOMMENDED DIELECTRIC TEST LEVELS FOR 1200 KV
P. Bellaschi

This group has completed its task of defining recommendations for test levels for future use on 1100 kV systems. The essence of these recommendations is:

3.3 Dielectric Test Subcommittee - L. S. McCormick (Con't.)

1. BIL levels shall be 2050, 2300 and 2550 kV.

2. Chopped wave levels at 100% of the full wave levels.

3. Induced test of 1040 kV to ground for one hour with a 7200 cycle enhancement of 1200 kV to ground.

4. Corona measurements the same as those to be adopted for the revised C57.12.00 dielectric test requirements.

5. BSL levels were left unspecified because arrester characteristics are still in a changing period.

The recommendations were turned over to the chairman of the Dielectric Test Subcommittee for any further action required to find them a home. Following this, the task force was disbanded.

I would like to commend and thank all the members of the task force and particularly its chairman, Peter Bellaschi, who put a great amount of effort and time into this project.

* * * * *

This concluded the reports of the working groups and there being no new business presented, the meeting was adjourned.

3.4 Dry Type Transformers Subcommittee - B. F. Allen (GE)

The Dry Type Transformers Subcommittee met at 1:00 p.m., October 26, 1982, with nine members and six guests present. The minutes of the Los Angeles meeting were approved. A summary of the Working Group activity is as follows:

The Working Group on Standards for Dry Type Transformers Incorporating Solid Resin Encapsulated Coils chaired by Mr. Ed Hoover met on Monday with 17 members and 9 guests present. Subsequent to the spring meeting in Los Angeles, the decision was made to request a revised scope for this project rather than close the initial exploratory project and open a totally new project. Accordingly, a revised scope for project PC57.12.01 was submitted to the Standards Board and was approved at the September, 1982 meeting. The revised scope covers developing specific wording for the new or revised requirements in C57.12.01 and C57.12.91 that were identified in the exploratory project. Four task groups have been organized to cover assigned parts of this project and have started their work. The task group chairmen are Messrs. Huber, Koenig, Rodden and Jonnatti.

3.4 Dry Type Transformers Subcommittee - B. F. Allen (Con't.)

The Dielectric Problems Working Group chaired by Mr. Jerry Corkran met on Monday with 10 members and 11 guests present. Draft 3 of the Guide for Conducting a Transient Voltage Analysis for the Dry Type Transformer Coil" had been submitted to the Working Group members for ballot prior to the meeting. A few editorial changes were discussed. Some ballots are still outstanding. It is expected that document will be balloted in the Subcommittee prior to the next meeting. David Barnard and Jack Rodden have joined this Working Group.

The Working Group to revise Loading Guide C57.96, chaired by Mr. Bill Mutschler, met on Monday with 9 members and 13 guests present. The fact that a constant winding hot spot instrument of 30° has been assigned and used for the three average winding rises of 80°, 115° and 150°C was brought up for discussion. It was generally agreed that for the purposes of this Loading Guide, the maximum allowable hottest spot rises of 110°, 145° and 180°C would be used to develop equivalent loading. Data is being solicited from Working Group members to confirm or revise the present exponents in the temperature vs. load equations. The present equations for calculating winding time constant need revision to reflect both aluminum and copper conductor. Data will be solicited from manufacturers to support such revisions.

Thermal Evaluation of Solid Resin Encapsulated Winding Insulation Systems--A discussion, chaired by Dr. George Bowers, was continued. This subject was initiated at the Spring Meeting in Los Angeles. Twenty people were present for this discussion. We were please to have Mr. Charles Snyder of CIBA-GEIGY Corp., present at this meeting. A project authorization request has been prepared and is being submitted.

3.5 Instrument Transformers - R. C. Thomas (Acutron)

The Instrument Transformers Subcommittee met October 26, 1982, in an all day session with seven members present and eight guests present. The chairman of the Task Force on Short Time Thermal Capability of Current Transformers was unable to attend. Therefore, there was no meeting of the task force. However, a questionnaire was prepared for submittal to the EEI/AEIC Meter and Services Committee for recommendations under practices of overloading current transformers. After reviewing this questionnaire, the Subcommittee is making a recommendation that this questionnaire not be limited to the EEI/AEIC Committee but to all users such as the government agencies, etc.

3.5 Instrument Transformers - R. C. Thomas (Con't.)

The rest of the day was spent in completing proposed revisions to C57.13.1978. Assignments were made for certain individuals to formalize certain sections of these proposed revisions into a draft for presentation at our Spring Meeting and then to letter ballot hoping that we will be able to meet that 5 year deadline by that time.

The NEMA Electrical Measurement Equipment Section transmitted to our Subcommittee their proposed draft of RIV testing and care and operation of instrument transformers for inclusion in the next revision of C.57.13. Time did not permit a discussion of this draft, but it was noted that it is essentially the material that has been in the NEMA Standards for instrument transformers for many years. Each member was given a copy of the draft to review and comment before our next Spring Meeting.

Draft #5 of a proposed Guide for Grounding of Instrument Transformers Secondary Circuits and Cases was prepared by the Relay Input Sources Subcommittee and was sent out to letter ballot. This is project P860, ANSI C57.13.3.

3.6 Insulation Life Subcommittee - C. McMillen (GE)

The meeting was opened by the chairman, Chuck McMillen, and all present introduced themselves. There were 25 members, 1 alternate, and 27 guests present, for a total of 53.

Minutes of the March 30, 1982 meeting in Los Angeles were accepted as written.

Reports of the Working Groups follow:

Working Group on Guides for Loading - R. Olsson, Chmn.

The Working Group met October 25, 1982 with a total attendance of 32, of which 15 were members and 17 were guests. The following new members are welcomed into the Working Group:

Mr. John W. Matthews, Baltimore Gas & Electric

Mr. Loren B. Wagenaar, American Electric Power Co. Service Corp.

A review of the status of active Guides and Task Force work was made:

Guide for Loading Transformers above 100 MVA.

Mr. Dave Douglas reported that after a successful ballot (80% response), negative positions were successfully resolved and editorial corrections were made. Draft 7 will be submitted to the IEEE Standards Board. There were two ballotings between March and October due to a sustained effort by Messrs. Douglas and Mitchell. It is expected that IEEE Standards Board review should be completed by mid-1983, and publication of the trial use document before year end 1983.

3.6 Insulation Life Subcommittee - C. McMillen (Con't.)

Guide For Loading Regulators

Mr. W. Wrenn reported the results of balloting on Draft 3 of this document. Of 46 ballots sent out, 29 were returned. Most of the comments were of an editorial nature, although there were 2 negative ballots. The latter were concerned with the use of distribution transformer insulation aging curves instead of those for power transformers (C57.91 vs. C57.92 curves). The Working Group had previously discussed this and had agreed to this use. It was also pointed out that test data is available to support this. The negative ballots were resolved.

One question on the ballot asked whether to continue to include the nomograph in the Guide. Results were 9 votes to retain it and 19 votes to delete it. At the Working Group meeting there was no additional support to retain it, hence it will be deleted.

The section covering loading by top oil temperature will also be deleted.

A review of the IEEE standards will be made to assure that appropriate terms are used, particularly for temperature.

Additions to the Guide will include a section covering regulator operation with 65°C insulation, an index of contents, and a foreword. The new draft will be balloted with the working group and the insulation life subcommittee before the next meeting.

Reactor Guide

The working group chairman reported that the task force now included members from 3 manufacturers. Mr. J. Matthews of Baltimore Gas and Electric volunteered to join the task force. By phone call to Mr. Caverly, the task force chairman, it was learned that between now and the next meeting an outline of the proposed Guide will be made. It is expected this will be distributed to the working group.

Task Force on Equations

Mr. J. Aubin gave a presentation of IEC's hot spot equations. These will be included in a separate mailing to the working group. A summary of various equations will also be sent to working group members asking them to review and raise questions so that a complete review can be made. In this manner, the review would permit reaffirmation or indicate where more detailed study is required.

IEC Guide For Loading

Mr. J. Aubin reported that no future meetings of the group developing the IEC "Guide For Loading" are planned; rather, completion will be accomplished through correspondence.

3.6 Insulation Life Subcommittee - C. McMillen (Con't.)

Working Group on Thermal Evaluation - A. Wurdack, Chmn.

The Working Group on Thermal Evaluation of Oil-Immersed Power and Distribution Transformers met at 8:07 A.M. Tuesday, October 26, 1982. Eight members and 10 guests were present.

Introductions were made, and the attendance list was circulated. The agenda and minutes of the last meeting were handed out. The minutes were approved as written.

The revised standard IEEE-345 (C57.100) was balloted in the Transformer Committee:

122 ballots were sent out
95 ballots were returned
10 affirmative with comments
1 negative
27 not returned

The comments and the negative vote were resolved by an editorial correction, and the ballot results and the revision submitted to the IEEE Standards Board. The Board will vote on the standard at their December meeting.

Bob Grubb's Task Force on "Dissolved Gas Analysis Coordination with Life Testing of Distribution Transformers" had no new members and no progress to report.

Dave Douglas and his Task Force were asked to report on the work for EPRI on Basic Transformers Life Characteristics work done by G.E. and Westinghouse. Dave reviewed the conclusions of the two reports. He also mentioned the new proposal by EPRI for additional work to be done on the subject of gas evolution. After some discussion it was agreed that Chairman A. Wurdack would take summaries of these three items and send them out to the Working Group and for further action at our next meeting. In particular, the W.G. members should determine if these reports satisfy our needs and whether more work on this or related areas should be attempted. We then need to convey our desires to others so they will know what work, if any, needs to be scheduled and to provide a guide for further study.

Working Group on Thermal Tests - R. Veitch, Chmn.

The Working Group met Monday, October 25, 1982 at 1:00 P.M. There were 11 numbers and 9 guests present.

The entire meeting was devoted to reviewing comments received on Draft 5 of the "Recommended Procedure For Performing Temperature Rise Tests at Loads Beyond Nameplate Rating".

3.6 Insulation Life Subcommittee - C. McMillen (Con't.)

Bob Grubb has compiled a summary of all comments of a non-editorial nature and had marked up Draft #5 with the editorial comments. This data was presented to all the members and guests at the meeting.

The following are the main points of discussion:
(a) In part A - "Recommended Procedures for Determining the Thermal Characteristics of an Oil-immersed Transformer", it was agreed that paragraphs 6.2, 6.3, and 6.4 would be reworked into a single paragraph and that the loading would be on the basis of current, not total losses, for 70%, 100% and 125% of maximum kVA rating. It was felt that loading by current would give more accurate results and take less time than loading based on total losses at each of the above conditions. One-hour gradient runs would not be required since loading is set by current. Corrections can accurately be made for the difference in losses - i.e. to accommodate the core loss factor - by plotting oil rise from the results obtained for the 3 runs and reading the higher oil rise based on total losses directly from the curve.

(b) A lengthy discussion then took place on whether part B, "Recommended Procedure for Performing Load Cycle Temperature Rise Tests", should also be carried out using current instead of total loss as a means of setting the test current. Draft 5 is written on the basis of loading to achieve total loss, i.e. load loss + core loss, for each loading condition. One of the main problems in this method is that an estimate of final temperature at a given load condition must be made before the test so that the load loss can be calculated. If the time for a given loading condition is short, say one hour, the oil and winding temperatures are still rising at the end of the test period. A shutdown has to be made at the end of the test period to determine winding rise and temperature but there is not time for the usual one hour gradient run at the proper current for the loading condition. Therefore a correction must be made to the measured winding gradient.

It was felt by many of the members that setting the current to obtain total loss and correcting the winding gradient would produce less accurate results than using the rated current only for the loading condition and making an oil rise correction for the core loss. It was agreed that the entire procedure would be much simpler if we used the current for each loading condition instead of estimating a higher current to achieve total losses for each loading condition.

It was agreed that Bob Grubb would generate a list of pros and cons for the two methods and forward this to all his task force members and the working group members for review and comment. This should be done in about one month as it is vitally important to make the correct decision before proceeding with Draft 6. All Task Force and Working Group members will review this information and forward their comments to Bob.

3.6 Insulation Life Subcommittee - C. McMillen (Con't.)

(c) There was a suggestion that acceptance criteria be omitted from the procedure. One reason for this is a statement that, "The analysis of gases shall not indicate thermal breakdown of the oil or excessive insulation degradation". Most members feel that acceptance criteria should be provided, otherwise there is no point in making the test. It was suggested that acceptable levels of gas generation should be provided in this procedure.

Although many manufacturers have their own criteria for acceptable levels of gas generation during a standard temperature rise test, there is not sufficient experience to set acceptance limits for temperature tests beyond nameplate rating. It was recommended that some group be asked to work on establishing acceptance criteria based on gas analysis for both standard temperature rise tests as well as tests beyond nameplate rating.

Guidance was requested from the subcommittee.

Much discussion followed concerning the taking of gas samples before and after standard temperature tests and tests at loads beyond nameplate, manufacturer's data and limits for gas evolution, the new EPRI request for proposal to further examine gassing, and whether a trial use document should include acceptance criteria. The decision was made to remove that criterion sentence from the proposed document.

R. Grubb is chairman of a Task Force to collect gas data from distribution transformer tests for IEEE #345. Mr. A. Wurdack will look into whether another Task Force is needed to collect gassing data from power transformers.

It was announced that the Power Engineering Society now limits the number of accepted papers to 53% of those submitted. Reviewers are urged to act fast when reviewing papers for presentation. W. Wrenn also implored fast action when responding to ballots.

New Business

Three new members are added to the membership list of the Insulation Life Subcommittee:

Mr. Olin Compton, Virginia Electric & Power
Mr. Dan Perco, Westinghouse Canada
Mr. Charles Brown, Florida Power and Light

Next Meeting

The next meeting of this subcommittee will be held April 10-13, 1982 in Atlanta.

3.7 Insulation Fluids Subcommittee - H. A. Pearce

The Insulating Fluids Subcommittee met on Monday & Tuesday, October 25 and 26, 1982, with 12 members and 10 guests present. Membership changes include the addition of Louis Gifford of Dow Corning to replace G. Coffman of Dow Corning and the addition of Terrell Hunt of EPA to replace Peter Niemiec of EPA.

Much of the time was spent in deiscussing and revising Draft #1 of the Guide for Handling and Disposal of Transformer Grade Insulating Liquids Containing PCB's, Project P799. A second draft will be prepared before the next meeting.

A preliminary discussion was held on the Working Group document on Project C57.111 Guide for Acceptance and Maintenance of Silicone Liquid in Equipment. It is hoped that this will be ready to send to the Subcommittee members by the next meeting.

Project C57.104 covers the Gas Guide and the extraction and interpretation sections are in need of revision. The Subcommittee members will prepare recommendations for consideration in the spring.

Any members of the Main Committee are invited to send comments to the Subcommittee Chairman and any items in the Gas Guide that may have caused a problem.

3.8 Performance Characteristics - O. Compton (Olin) VEPCO

3.8.1 Working Group on Transformers Connected to Gnerators

The working group met with 7 members and 7 guests. The minutes of March 29, 1982 were approved without change.

Two membership changes were noted. Mr. Jim Walton of Sterns and Rogers was added as a new member and Mr. Bipin Patel of Southern Company Services replaced Mr. John Woodall of the same company. We welcome these new members and thank Mr. Woodall for his past contributions.

The investigation results of a parallel capacitor/inductor filter circuit connected to the neutral high voltage winding terminals of the unit transformer used for subsynchronous reasonance suppression that was brought out at the last meeting was discussed. The application of this filter can have the effect of reducing the unit transformer impedance up to 40% during fault conditions. Input obtained from S. Benko of Southern California Edison was discussed. It was the concensus of the working group that this was such a special case and most likely will not be applied generally to unit systems, that it need not be included in the guide.

3.8 Performance Characteristics - O. Compton (Con't.)

3.8.1 Working Group on Transformers Connected to Generators (Con't.)

The working group then turned its attention to the review of Draft 3 of the guide. Since the last meeting previously agreed to Editorial changes were included in Section 3 (The Introduction), while Section 5 (Selection of Voltage Ratings of the Unit Transformer) was completely rewritten. Also Section 6 (Transformer Design Considerations), was also rewritten.

The chairman noted that additional generator decrement curves were needed since only the Westinghouse excitation systems were represented in the Appendix. Mr. L. Stensland will try to obtain General Electric data, while Mr. Jim Walton will attempt to obtain Seimens-Allis data. These decrement curves will be compared and the Appendix made such that representative curves are presented.

Comments on Sections 3, 4 and 6 were reviewed and incorporated into the document. It is planned to ballot Draft 3 in the working group and if most comments are editorial in nature, be submitted to the subcommittee. This will most likely be after the spring of 1983 meeting.

3.8.2 Short Circuit Duration Working Group

The Working Group on Short Circuit Duration met on October 25, 1982 with 11 members and 20 guests in attendance. A summary of Letter Ballot P784/D6 was presented as follows:

	Number	Percent of Ballots Mailed	Percent of Ballots Returned
Total ballots mailed	124	100	-
Total ballots returned	104	84	100
Affirmative ballots received	96	77	92
With Comments	93	75	89
Without Comments *	3	2	3
Negative ballots received *	2	2	2
Not Voting ballots received	6	5	6
Number of ballots not returned	20	16	-

3.8 Performance Characteristics - O. Compton (Con't.)

The meeting then progressed with discussion of the two negative notes and comments as received on D6. The negative votes were soon resolved by deletion of phrase describing right-hand curve as one "representing an acceptable although somewhat higher risk level than the curve on the left."

Following this, some rather minor editorial changes were made to complete what becomes D7 - a document determined to be acceptable for presentation of the Standards Committee as a Transformer Through Fault Current Duration Schedule. This W.G. can now pending approval of Standards Commitee be considered as having completed its assignment.

3.8.2 Harmonic Load-Current Heating Working Group Meeting

I. E. F. Troy called the meeting to order at 8:00 am.

II. The attendance list is attached.

III. Announcements

A. Personnel changes

- William P. Gibbons, USAF, joined the Working Group as a member.

IV. Discussion of 9/20/82 draft of "Recommended Practice for Establishing Transformer Capability When Supplying Nonsinusoidal Load Currents."

A. Paragraph 5.3(3) was discussed in some detail. This paragraph will be redrafted to incorporate the views expressed.

B. Section 3 will be completed to include all symbols used.

C. The affect of high di/dt associated with line notching, as raised by Jim Walton, was discussed. It was concluded that this was a voltage phenomenon and as such was beyond the scope of this document. The subject was referred to the Rectifier Transformer Task Force for consideration in that standard.

D. The revised draft, Draft 1, will be submitted to the Working Group for ballot.

3.8 Performance Characteristics - O. Compton (Con't.)

3.8.2 Harmonic Load-Current Heating Working Group Meeting (Con't.)

V. Ed Cham, chairman, Rectifier Transformer Task Force, reported:

A. Minimum rating of Transformers to be covered by that standard will be:

- 301 kVA single phase
- 501 kVA 3 phase

B. Standard will include:

- Liquid insulated transformers
- Dry type transformers
- Cast coil transformers

C. Standard will not be a free-standing document, but will refer to existing standards such as:

- IEEE 100
- ANSI C34.2

VI. Meeting was adjourned at 9:20 am.

3.8.4 Working Group on Qualification of Class 1E Transformers for Nuclear Power Generating Stations -

MEMBERS PRESENT:

B. F. Allen
W. H. Mutschler
L. R. Stensland

GUESTS PRESENT:

E. Chitwood
K. Linsley
A. D. Kline

The Working Group met in Philadelphia, PA. at the Holiday Inn - Center City, on Sunday, October 24, 1982 with three members (out of a total six) and on Monday, October 25, 1982 with three members and three guests.

The minutes of the March 29, 1982 meeting were approved as written.

3.8 Performance Characteristics - O. Compton (Con't.)

3.8.4 Working Group on Qualification of Class 1E Transformers for Nuclear Power Generating Stations (Con't.)

The negative ballots received on P638, Draft 11 were reviewed. The Working Group has been able to review about all of the negative ballots, except those pertaining to Section 7. Mr. Bill Mutschler will contact Mr. Carl Hurty to help in revising Section 7. It is expected that a new draft of P638 is to be issued shortly after the first of the year.

The comments on the revision to IEEE Standard 323, Draft 12 were returned to IEEE/NPEC/WG 2.0 Chairman in August 1982. The writer thanked Mr. Ben Allen for his comments on this draft.

In September, 1982, Draft 13 of the previous mentioned Standard was reviewed. It is possible that aging may not be required for equipmen located in a mild environment. This will be reviewed further with the Chairman of the IEEE/NPEC/WG 2.0 prior to issuing Draft 12 of P63

3.8.5 Working Group on Transformer Reliability

The Working Group on Transformer Reliability met on Monday, October 25, 1982, at the Holiday Inn, Philadelphia, PA. The meeting was conducted from 1:00 p.m. to 2:50 p.m. and was attended by 11 members and 9 guests. Membership of the Working Group is currently 28. After introduction of members and guests the minutes of the previous Working Group meeting were approved w/o comment.

Between our last meeting and this one the working group task force had held a meeting at which time draft #3 was generated and balloted in the Subcommittee and Working Group. The results of this ballot were combined and reported as a combined ballot for the Subcommittee and Working Group. At a task force meeting held Sunday, October 24, 1982, from 2:00 p.m. to 5:00 p.m. it was pointed out that this ballot result should be separated and reported as a Subcommittee ballot only. This will be done in the immediate future with the results distributed to the Subcommittee and Working Group members.

Draft #3 brought forth 3 major issues where negative ballots were received before this meeting and another issue brought out just before our meeting.

3.8 Performance Characteristics - O. Compton (Con't.)

3.8.5 Working Group on Transformer Reliability (Con't.)

The negative issues discussed at our Working Group meeting were:

1. *The tone of this document is such that it is not written as a guide. The total document will be reviewed in an effort to eliminate this issue. All of the shall's and should's will be reviewed completely.*

2. *Section 3 on Confidentiality received a negative ballot. This section will also be reviewed. The approach which will be used to retone the guide may also address section 3. This may take the form of: If Confidentiality is desired, here is the approach to be taken. General agreement indicated that there should be some means for any group using this guide to address the subject of Confidential information. It is foreseen that in the future, both users and manufacturers would have access to this information by way of a computer terminal or CRT's.*

3. *Liability litigation is a major concern and a negative ballot was returned as a result of it. This subject will have to be thoroughly explored. This was one concern many years ago when this group was initially organized. The Working Group Chairman will investigate this issue. Others of the Working Group are asked to do likewise and the subject will be a continued agenda item.*

Our last negative, received at this meeting, is a philosophical issue and although has merit is an issue which cannot be addressed w/o rejecting all we have accomplished to date. It also mentioned anti-trust which doesn't really exist, unless IEEE or some other organization acts as a single body. As long as independent decisions are made by member companies, anti-trust does not become an issue.

The task force within our Working Group now has some meaningful redirection, which is what we wanted from a ballot to the Subcommittee. We will produce draft #4 to be balloted before our next meeting.

Draft #3 was sent to external organizations: IAS, DOE, EPRI, CIGRE WG 12.05, CEA, the T&D, Substation, Power Generation Subcommittees of IEEE, NPEC SC5 Rel. WG 3, ETTC, IEC TC-56, Stand Co. Comm. 10 on Definitions, ASQC and NEMA.

An issue of new business was the possibility of developing a Working Group under the Performance Characteristics Subcommittee to explore the methods of failure analysis.

3.8 Performance Characteristics - O. Compton (Con't.)

3.8.5 Working Grup on Transformer Reliability (Con't.)

Results of Draft 3 - Guide for Transformer and Shunt Reactor Reliability Reporting and Analysis - Standards Project P786

45 Ballots sent to members of the Performance Characteristic Subcommittee

35 Ballots were returned	: $\frac{35}{45}$	=	*77.77% returned*
10 Ballots were not returned	: $\frac{10}{45}$	=	*22.22% not returned*

Of those 35 returned ballots:

5 approved with comments	: $\frac{5}{35}$	=	*14.28%*
20 approved	: $\frac{20}{35}$	=	*57.15%*
25 approved or app. w/comm.	: $\frac{25}{35}$	=	*71.43%*
7 not approved *5 on same issue, therefore, 3 separate issues*	: $\frac{7}{35}$	=	*20.0%*
3 not voting	: $\frac{3}{35}$	=	*8.57%*

There were 14 copies sent in a liaison effort to outside organizations, 8 were returned.

1 - not approved - minor issues, easy to resolve.
2 - approved w/comm.
5 - approved.

3.8 Performance Characteristics - O. Compton (Con't.)

3.8.6 Working Group on Loss Tolerance and Measurement

The Working Group on Loss Tolerance and Measurement met at 8:00 A.M., Monday, October, 25, 1982, with 15 members and 13 guests attending. Minutes of the previous meeting were approved with no comment. The results of four ballots were discussed at the meeting of the Working Group.

Corrections to Load Loss Measurement - Transformers Committee Ballot
(Proposed addition to C57.12.90 - 1980, Section 9.2.4.2, Draft 3)

The first ballot reviewed was the proposed addition to C57.12.90 concerning phase angle error correction to load loss measurements balloted at the Transformers Committee level. The ballot results were:

Approved	82
Approved w/comment	4
Not approved	2
Not voting	8
Not returned	30

As a result of some of the comments, editorial changes were made in the proposal. The Working Group will try to resolve the remaining two negative votes, then either a circulation of change or another ballot will be issued at the Transformers Committee level. (Mr. Dutton and Mr. Stetson were not present at the meeting to defend their negative ballots.)

Voltmeter Connection for No-Load Loss - Working Group Ballot
(Proposed addition to ANSI C57.12.90 - 1980, Section 8.3.2.1, Draft 3)

The second ballot considered was Draft 3 of a Working Group proposal on voltmeter connection for no-load loss measurement. The ballot results were:

Approved	11
Approved w/comment	1
Not approved	1
Not returned	7

Comments from Floor:

Al Goldman noted that confusion exists on specifying secondary MVA ratings and impedances referenced at different impedance bases. Mr. Goldman is to write a letter to Mr. Compton requesting specific actions.

3.9 Recognition and Awards - J. V. Bonucchi

There was no report.

3.10 The Standards Subcommittee - L. R. Smith

All subcommittees except the Audible Sound and Vibration Subcommittee reported up-to-date status of their projects. The status on the projects under the Audible Sound and Vibration Subcommittee will be furnished as an addendum to this report when determined.

Two new projects have been approved:

PC57.104 - ANSI/IEEE Std. C57.104 - Guide for the Detection and Determination of Generated Gases in Oil-Immersed Transformers and Their Relation to the Serviceability of the Equipment

P954 - Guide for Acceptance and Maintenance of High Temperature Hydrocarbon Liquid in Equipment Under Insulation Fluids Subcommittee

Project authorization requests have been submitted for the following proposed projects:

ANSI-C57.21 - Revision of Dielectric Test Requirements for Shunt Reactors Under Dielectric Tests Subcommittee, Revision of Dielectric Tests Working Group

ANSI-C57.93 - Guide for Installation of Liquid-Immersed Power Transformers Under West Coast Subcommittee, Installation Guide Consolidation Working Group.

A task force has been formed to consider action on Trial Use Document 262B (Dielectric Tests of Transformers for Use on Effectively Grounded Systems 345 kV and Above).

Mr. Ron Little has replaced Mr. R. G. Jacobsen as chairman of the West Coast Subcommittee. Mr. Little's address and phone number are:

The Washington Water Power Company
P.O. Box 3727
Spokane, Washington 99220
(509) 489-0500 ext. 2409

My records have the chairmen as listed below:

R. E. Liebich	Audible Sound and Vibration
J. K. Easley	Bushing
L. S. McCormick	Dielectric Tests
B. F. Allen	Dry-Type Transformers
O. R. Compton	Performance Characteristics
H. A. Pearce	Insulating Fluids
C. J. McMillen	Insulation Life
R. C. Thomas	Instrument Transformers
Ron Little	West Coast
L. R. Smith	Standards

3.10 The Standards Subcommittee - L. R. Smith (Con't.)

The following is a summary of the activities and status of the various subcommittee projects.

Project Status

PC57.12.00 - General Requirement for Liquid-Immersed Distribution Power and Regulating Transformers

Still being discussed in the working group.

PC57.12.01 - General Requirements for Dry-Type Distribution and Power Transformers

Desirable changes related to solid resin-encapsulated coils have been identified. The development of specific proposals is underway.

PC57.18.10 - Semi-Conductor Rectifier Transformer

Working on definitions. Ballot still some time off.

PC57.21 - American National Standard Requirements, Terminology and Test Code for Shunt Reactors

New task force formed. New Chairman is Jack McGill.

PC57.95 - Loading Guide for Regulators

Draft #3 ballot out to working group.

PC57.96 - Guide for Loading Dry-Type Distribution and Power Transformers

The working group continues to consider various changes.

PC57.104 - Guide for the Detection and Determination of Generated Gases in Oil-Immersed Transformers and their Relation to the Serviceability of the Equipment

New project. Will be discussed in October in Philadelphia.

PC57.110 - Harmonic Load Current Heating of Transformers

First draft prepared for ballot. Coordination being accomplished.

PC57.111 - Guide for Acceptance and Maintenance of Silicone Liquid in Equipment

First draft being prepared.

P21 - Revision of ANSI C76.1

No change since March 1982.

3.10 The Standards Subcommittee - L. R. Smith (Con't.)

P24 - Revision of ANSI C76.2

Stalled in Standards Board office.

P65 - Thermal Evaluation of Ventilated Dry-Type Power and Distribution Transformers

Now being balloted in ANSI C57.

P76 - IEEE Guide for Acceptance and Maintenance of Transformer Askarel in Equipment

Need information on the status of this project.

P93 - Transformer Impulse Tests (C57.98)

Approved by Standards Board.

P262E - Revision of C57.12.90 Loss Tolerances

Ballot D3 sent to full subcommittee to be returned by September 1982. Ballot is on section 9.2.4.2 - Corrections to Load Loss Measurements.

C57.12.90; 8.3.2.1 Voltmeter Connection for No-Load Measurement
Draft #3 of working group ballot being discussed.

C57.12.90; 8.1 & 8.2.2 No-Load Loss Temperature Correction
Draft #2 of working group ballot ready for working group discussion.

C57.12.90; 8.2.1 Awaiting additional data.

P345 - Review of IEEE Std. 345-1972 Test Procedures for Thermal Evaluation of Oil-Immersed Distribution Transformers (C57.100-1974)

Approved by Transformers Subcommittee and submitted to Standards Board to be acted on at December Board meeting.

P462C - Revision of C57.12.00 Loss Tolerance and Measurements

Working group ballot #2. Ready for discussion.

P513 - Seismic Guide for Power Transformers and Reactors

No change since March 1982 report.

P462D C57.12.00; 9.1 Ratio Tolerance Requirement
No progress. The work has been reassigned.

P523 - Guide for the Control of Transformer Sound
Withdrawn. Work covered elsewhere.

3.10 The Standards Subcommittee - L. R. Smith (Con't.)

P545 - Recommended Practice for Partial Discharge (Corona) Tests for Transformers

Still being discussed in working group.

P546 - Revision of ANSI Requirements for Instrument Transformers C57.13-1978.

No activity since March 1982.

P637 - Proposed Guide for the Reclamation of Insulating Oil and the Criteria for Its Use

Approved by Standards Board.

P638 - Standard for Type Tests on Class 1E Transformers for Nuclear Power Generating Stations

Attempting to resolve negative ballots on subcommittee Draft #11.

P670 - Switchgear and Transformers Working Group on Instrument Transformers for High-Voltage Circuit Breakers

Subcommittee reports no progress.

P731 - Revision of Guide for Loading Current Limiting Reactors, ANSI C57.99

We now have a chairman for this task force.

P732 - Revision of Current Limiting Reactor Standards, ANSI C57.16

Need information on this working group. Under what subcommittee?

P740 - Dielectric Test Requirements for Power Transformers for Operating at System Voltage from 69 through 230 kV (C57.XX)

Report approved by Standards Board in March but still not published.

P745 - Guide for Conducting a Transient Analysis for Dry-Type Transformers (C57.XX)

Still under discussion in the working group.

P756 - Guide for Loading Transformers Above 100 MVA

Now being balloted in Transformers Subcommittee.

P757 - IEEE Guide for Loading Power Apparatus Bushings

Stalled in Standards Board office.

3.10 The Standards Subcommittee - L. R. Smith (Con't.)

P784 - Transformer Through Fault Current Duration Guide

Draft #6 currently being balloted.

P785 - Transformers Connected to Generators

Draft #3 ballot results being reviewed.

P786 - Transformer Failure Reporting and Reliability Analysis

Working group ballots due back October 1, 1982.

P799 - Guide for Handling and Disposing of Askarels

There will be an in-depth review of first draft at the meeting in Philadelphia.

P800 - Bushing Application Guide

No progress since March 1982.

P801 - Recommendations for Revisions to ANSI C57.15 Requirements, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators

Draft #5 has been balloted in working group with four approved (three with comments) and one not approved. Discussion of these items will be the agenda in Philadelphia.

P832 - Detection and Measurement of Partial Discharge (Corona) in Instrument Transformers

No change reported since March 1982.

P838 - Guide for Performing Overload Heat Runs

Now preparing Draft #6 of this proposed project.

P842 - Loss Evaluation Guide

Draft #5 was presented to West Coast Subcommittee during summer power meeting in San Francisco.

P852 - Bushings to Operate in Gas-Insulated Substation

No progress to report since March 1982.

There are still a few projects which I have been unable to get a handle on:

P670 - Instrument Transformers for High-Voltage Circuit Breakers

Last reported action was mailing of ballot P670/D4 dated September 16, 1980.

3.10 The Standards Subcommittee - L. R. Smith (Con't.)

P732 - Current Limiting Reactors

Last report was in March 1980 when D. A. Duckett resigned and a new chairman was being sought.

P832 - Partial Discharge in Instrument Transformers

The committee was to investigate to see if this work should be incorporated into C57.13.

If readers of this report note any projects listed that are no longer active or valid and should be removed, or if any active ones are not listed, please let me know so that I can add or delete as necessary. Please furnish P number, title, and relation to IEEE or ANSI Standard.

3.11 West Coast Transformers Committee - R. G. Jacobson for Ron Little

The West Coast Subcommittee met on July 22, 1982, at the Summer Power Meeting in San Francisco. The chairman for the next two years will be Ron Little of the Washington Water Power Co. in Spokane, Wash.

P842 - Loss Evaluation Guide for Transformers and Reactors. Draft 5 was presented to the members at the July meeting.

C57.93 - Proposed Guide for Installation of Liquid-Filled Power Transformers. A request for Standards project authorization has been sent in. No reply has yet been received.

P513 - Seismic Guide for Transformers. No change since the last report.

The West Coast Subcommittee is planning to meet with the West Coast Substation Subcommittee in February, 1983, in Phoenix, Ariz.

Comments from the Floor:

O. Compton requested a meeting be held for the people working on the Loss Evaluation Guide.

C. Honey requested that formulas utilities use be sent to the West Coast Subcommittee.

4.0 Liaison Reports - W. J. McNutt

4.1 EPRI - E. T. Norton

It was noted that there was nothing to report.

4.2 DOE - D. E. Massey

There was no report.

4.3 Other Liaison Reports

ANSI C76 second liaison position was filled by L. Wagenaar.

The document on power line carrier equipment and CVVT's, ANSI C93.4, was given to each Subcommittee chairman and copies were made available.

4.3.1 Liaison Report on IEC Activities - J. C. Dutton

For information, the present Members of the IEC TC-14 Technical Advisory Group (TAG) are listed below:

J. C. Dutton - Chairman
C. H. White - Secretary

L. W. Long
R. T. Uptegraff
R. L. Ensign
C. R. Murray
J. C. Dutton
R. B. Stetson
A. C. Wurdack
} ANSI C57

W. J. McNutt
L. J. Savio
D. A. Yannucci
B. F. Allen
J. V. Bonucchi
O. Compton
J. K. Easley
R. E. Liebich
L. S. McCormick
C. J. McMillen
H. A. Pearce
} IEEE

E. R. Uhlig
C. Ludeke
P Hopkinson
} NEMA

4.3.1 Liaison Report on IEC Activities - J. C. Dutton

IEC Technical Committee 14 (Transformers) has been rather dormant since the recent printing of IEC Publication 76-3 1980, Power Transformers Part 3: "Insulation Levels and Dielectric Tests."

Correspondence with the TC-14 Chairman, Mr. F. C. Pratt, indicates that TC-14 is tentatively planning to meet in 1983, but apparently the time and place are not yet determined.

Two newly announced standards (listed in the July 1982 IEC Bulletin) which may be of interest are:

726 (1982) "Dry-Type Transformers"
39 pp. Fr.s. 51.

727 "Evaluation of Electrical Endurance of Electrical Insulation Systems
727-1 (1982) Part 1: General Considerations and Evaluation Procedures Based on Normal Distributions"
31 pp. Fr.s. 40.

(These can be obtained through ANSI.)

4.3.2 Liaison Report on ANSI C57 Committee Transformers - J. C. Dutton

The ANSI C57 Committee last convened in April 1982 in Los Angeles following the meeting of the IEEE Transformers Committee. The next meeting is planned in April 1983 in Atlanta, Georgia.

The sheet showing the "Status of IEEE and ANSI C57 Ballots, and Printing" (attached) shows many standards printed. In general, it appears that most transformer standards documents are up-to-date and current, with a few still involved in balloting or printing.

Other ANSI Transformer Documents recently printed include:

ANSI C57.12.20-1981
ANSI C57.12.25-1981
ANSI/IEEE C57.13.1-1981

IEEE Headquarters recently reviewed and revised the IEEE Delegation to compensate for retirements, resignations, etc. The current Delegation includes:

John C. Dutton, Chairman - IEEE Delegation to ANSI C57 (TR)
L. W. Long (TR)
L. S. McCormick (TR)
O. R. Compton (SUB)
J. V. Bonucchi (TR)
E. R. Smith (IPPS)

The current Chairman of the ANSI C57 Committee is L. W. Long, and the Secretary is C. H. White (of NEMA).

ANSI has recently published "Procedures for the Development and Coordination of American National Standards," dated September 1, 1982. It is expected that the new procedures described in this booklet will affect the organization of ANSI Transformer Committees during the next few years.

4.3.3 Status to IEE and ANSI Ballots - J. C. Dutton

ANSI C57
BALLOT NO.

IEEE PROJ. NO.	IEEE BRIEF DESCRIPTION	IEEE STD BD SUBM.	ANSI C57 COMM SUBM.	ANSI BSR SUBM.	EDIT, TYPESET	PRINTING
348 P733	C57.21 (Shunt Reactors)	C	C	C	C	Printed
349 P547	C57.94 (Dry-Type Rec. Pract.)	C	C	C	C	Printed
353	HVACC, C57.12.55, Dry Type	N/A	Reballot			
354	HVACC, C57.12.27, Dist. Tr.	N/A	C	C	IP	Printed
355	HVACC, C57.12.13, Power Tr.	N/A	C	C	IP	Printed
356	HVACC, C57,13.2, Inst. Tr.	N/A	Reballot			
358	C57.12.24-1982, Dist. Tr.	N/A	IP	C	C	Printed
359	C57.12.40-1982, Dist. Tr.	N/A	IP	C	IP	Printed
	C57.12.14, PT DielTests (Trial Use Document)	C	N/A	N/A	IP	Expected 10/82
	ANSI/IEEE C57.12.56-198X Dry-Type Insul. Testing (Models) (Formerly known as IEEE 65)	C	Balloting			
	ANSI/IEEE C57.98-1982 Impulse Test Guide	C				

Bltg. = Balloting IP = In Process C = Complete N/A = Not Applicable

4.3.4 Other ANSI Committees

ANSI C57.12.1 - POWER TRANSFORMERS (D. C. DUTTON)

Work has been in progress to update ANSI C57.12.10-1977 and ANSI C57.12.30-1977, and to combine these in a single document with a goal of eliminating as much duplication as possible.

Meetings were held in Washington, DC, September 22 and 23, 1982 by the NEMA Technical Committee and the ANSI C57.12.1 Power Transformer Subcommittee to review and comment on a draft of this proposal.

Also discussed at these meetings were comments and proposals of Mr. R. Beckwith relative to LTC transformer control standards.

ANSI C57.12.2 - TASK FORCE ON DISTRIBUTION TRANSFORMER PRESSURE RELIEF (C. KAPPELER

This subcommittee met in St. Louis on October 14, 1982

Standards C57.12.21 and C57.12.22 issued in 1980 and C57.12.20 issued 1981 are being reviewed for revisions. Any desired changes should be directed to the appropriate Working Group Chairman.

Standard C57.12.26, draft X, will be ballotted with goal of being approved before year end.

It has been proposed that a standard be developed for dual voltage and Δ-Y transformers.

The practice of installing transformers on poles in the horizontal position, as well as allowable tilt on both pole and padmounts, were discussed. As this appears to be an installation or application problem, it is requested that this problem be studied and acted upon by IEEE.

ANSI C57.12.4 AND C57.12.5 SUBCOMMITTEES - (J. C. DUTTON)

These Subcommittees working jointly have begun to develop a standard for dry type network transformers.

ANSI C57.13 - INSTRUMENT TRANSFORMERS (R. C. THOMAS)

No Committee meeting.

ANSI C57.15 - VOLTAGE REGULATORS (A. C. WURDACK)

No Committee meeting.

4.3.4 Other ANSI Committees (Con't.)

ANSI C62 - SURGE PROTECTIVE DEVICES AND IEEE SPD COMMITTEE (E. J. YASUDA)

Spring 1982 Surge Protective Devices Committee Meeting

The IEEE Surge Protective Devices Committee (SPD) held its Spring 1982 Meeting at the Chase Park Plaza Hotel in St. Louis, Missouri, May 3-7, 1982.

A new Working Group, on Surge Protection for Dispersed Storage Generation System, was established under the Application of Surge Protective Devices Subcommittee. The W.G. scope calls for the review of existing standards, regulations, and codes pertaining to system grounding and surge protection. In the process, evaluate and recommend the adequacy of these documents for application to dispersed storage generation system. The W.G. will also review standards, regulations, and codes being developed by other entities as appropriate.

Parts 1 (Introduction) and 2 (Grounding on Synchronous Generator Systems) of the Neutral Grounding Guide, IEEE 143 are presently being balloted within the Neutral Grounding Devices Subcommittee, chaired by E. R. Taylor, Jr. Other parts of the guide being developed, include Grounding Guide for Auxilliary Systems, Guide for Grounding Distribution Systems, and Guide for Grounding Transmission and Subtransmission Systems.

The SPD negative ballots on the revisions of C62.1 to establish test requirements for the new heavy duty distribution class arresters were resolved. The proposed revisions will be forwarded to the IEEE Standards Board for approval.

The W.G. on Arrester Protection and Coordination - Transformer Insulation did not meet during this meeting. Laboratory test with steep-front current impulses on a transformer (with an arrester) is still being planned at the OB test laboratory. This will validate computer studies which have been performed to obtain the maximum voltage across the transformer winding following arrester operation. The more recent activity of the W.G. related to the review of the proposed revisions to the dielectric test requirements of C57.12.00 and C57.12.90. Comments were submitted to the chairman of the W.G. on Revision of Dielectric Tests.

The metal-oxide surge arrester (MOSA) standard is actively being developed. Draft #5 of th partially completed document is currently being reviewed by the W.G. Concurrent with this activity, the W.G. is actively participating with the corresponding MOSA standard development in IEC.

4.3.4 Other ANSI Committees (Con't.)

The Fall 1982 SPD Meeting in Memphis, Tennessee will include a panel discussion on Electrical Protection of CATV. Panel members will be made up from CATV, telephone, electric power utility, and REA representatives. The panel discussion will address such aspects as applicable codes, regulations as well as design considerations an cooperation between CATV, telephone and electrical power utilities.

ANSI C68 - TECHNIQUES FOR DIELECTRIC TESTS (L. S. McCORMICK)

No activity. No report.

ANSI C76 - BUSHINGS (N. J. MELTON)

No activity to report.

ANSI C84 - PREFERRED VOLTAGE RATINGS (J. C. DUTTON)

Work to revise ANSI C84.1 has been completed and (as of 10/13/82) the proposed revision is being considered for final approval by the ANSI Board of Standards Review. It is expected that this revision of ANSI C84.1 will be printed in 1982.

ANSI C89 - SPECIALTY TRASNSFORMERS (S. J. ANTALIS)

1. No ANSI C89 Meetings were held in 1982.

2. Work is going on in NEMA ST-8 Technical Committee to revise NEMA ST-20 (ANSI C89.2) removing references and sections relating to transformers above 600 volts. This will avoid conflict with the new Standards on high voltage published recently (ANSI C57.12.01, C57.12.91, C57.12, 50, 51, 52). This work was approved at the November 1981 NEMA Annual Meeting.

ANSI C92 - INSULATION COORDINATION (J. C. DUTTON)

With the completion of the revisions of ANSI C92.1-1982 and ANSI C92.2-1981, the current work of the C92 Committee appears in good condition. C92.1-1982 is being printed, and C92.2-1982 is printed. ANSI C92 Committee meetings are scheduled in Atlanta December 1 and 2, 1982.

4.3.5 IEEE Committees

IEEE JOINT COMMITTEE ON NUCLEAR POWER STANDARDS (L. R. STENSLAND)

The IEEE/NPEC/SC-2 met on April 20 and 21, 1982.

1. P600, "Standard for Accreditation of Organizations that Perform Qualification Testing of Equipment for Use in Nuclear Power Generating Stations" - was approved by NPEC.

2. The Working Group on the Qualification of Class 1E Transformers returned comments in August to NPEC/SC-2 on P.323/D.12.

3. The tentative NPEC/SC-2 meeting is scheduled for October 20 and 21, 1982, in Washington, D.C.

IEEE W.G. NO. 70.1 - GAS INSULATED SUBSTATIONS (D. J. CASH)

No report available.

4.3.6 CIGRE

REPORT OF ACTIVITIES IN CIGRE SC-12 TRANSFORMERS

(W.J. McNutt - U.S. Representative to CIGRE SC-12)

A meeting of SC-12 took place in Paris on September 6 in conjunction with the CIGRE 1982 General Session. Plans were set for a Transformer Colloquium to be held in Aachen, Germany in September 1983. Discussion subjects will be:

1. Thermal aspects of transformers.

2. Terminal connections (Bushings)

3. Cores and core steel.

Work in the U.S. and IEC on revised loading guides has stimulated new interest in thermal aspects - loadability, hot spot measurement, temperature limitations. There were suggestions to form a Working Group, but that action was postponed until after the colloquium discussions. One item of note was the fact that direct reading hot spot sensors have been installed in two production transformers in the U.K. These operate on the principle of measuring the vapor pressure of a volatile liquid contained in a capsule buried within the winding. The capsule is made of stainless steel and measures 8 x 2.5 x 50 mm. Sweden also reported experience with fiber optic temperature sensors in a prototype transformer.

The first two colloquium subjects will be carried forward as preferential subjects for the 1984 General Session. In addition, there will be general discussion of "Part Winding Resonances" with invited participation from SC-33. (Overvoltages and Insulation Coordination). The SC-12 Working Group on this latter subject has been reorganized under the direction of Dr. G. Preininger of Austria. Interest is high in that many countries have experienced transformer field failures which they now attribute to excitation of an internal natural frequency by an external oscillatory switching voltage. I was asked to provide the Working Group with data on natural frequencies of transformers of U.S. manufacture, particularly those of shell form construction, and I will be seeking such information in our Working Group.

At the suggestion of the U.S. Technical Committee I raised the question of detection, containment and disposal of PCB compounds as a possible SC-12 Working Group subject. Some interest was shown by representatives from Japan, Australia and Italy, but the conclusion of the group was that the subject was not of general interest to the CIGRE community. The opinion was expressed that allowable PCB limits is more of a political problem than a technical one. It was suggested that the matter be referred to SC-15 (Insulating Materials) by the SC-12 liaison member.

4.3.8 National Electric Code - E. J. Huber

Attached are copies of pages 246 and 247 of the National Electrical Code Technical Committee Report (preprint of Proposed Amendments for the 1984 NEC). The action proposed for Section 450-23 may be of interest to those involved with liquid-filled transformers employing a "less-flammable" liquid, sometimes called "high fire point" liquid.

If anyone wishes to comment on the proposal for Section 450-23, or any other portion of the preprint, please note that comments should be sent to:

National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269

To be considered at the next Code-making panel meetings, comments must be received by NFPA by November 1, 1982.

4.3.8 National Electric Code - E. J. Huber (Con't.)

13- 18 - (450-23): Accept
SUBMITTER: CMP 13
RECOMMENDATION: 450-23. Less-Flammable Liquid-Insulated Transformers. Transformers insulated with listed less-flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings, provided there is a liquid confinement area, the liquid has a fire point of not less than 300°C, and the installation complies with all restrictions provided for in the listing of the liquid. Such indoor transformer installations not meeting the restrictions of the liquid listing, or installed in combustible buildings or combustible occupancy areas, shall (1) be provided with an automatic fire extinguishing system and a liquid confinement area, or (2) be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall comply with the safeguards of Section 450-27.

(FPN) As used in this Section "Noncombustible" refers to Type I and Type II building construction and noncombustible materials as defined in Types of Building Construction, NFPA 220-1979.

(FPN) See definition of "Listed" in Article 100.

SUBSTANTIATION: This proposal addresses the subject of Proposals 13-19, 13-20, 13-21, 13-22, and 13-23 and in the opinion of CMP 13 provides reasonable safety for the installation of less-flammable liquid-insulated transformers.
PANEL ACTION: Accept.
VOTE ON PANEL ACTION:
AFFIRMATIVE: 11
NEGATIVE: Boyd.
COMMENT ON VOTE:
HUBER: The terminology "noncombustible" as used in Section 450-23 of the proposal is not strictly correct. NFPA 220 refers to and defines only "combustible" materials. "Occupancies" are defined in NFPA 101 based on the area activity or purpose; such as assembly, educational, health, penal, residential, mercantile, business, industrial, and storage. This should be clarified.
EXPLANATION OF VOTE:
BOYD: In favor of the proposal as a whole but feel that more consideration should be given to the use of the terms "combustible" and "noncombustible."

Log # 97

13- 19 - (450-23): Accept in Principle
SUBMITTER: Ed Fielding, Ed Fielding Electrical Contractor Corp.
RECOMMENDATION: Revise fourth paragraph as follows:
Less-flammable liquid-insulated transformers installed outdoors shall comply with the safeguards of Section 450-27.
SUBSTANTIATION: The reference as presently written is unclear. It could be interpreted that outdoor installations are to be oil-insulated transformers.
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal was accepted in its entirety and incorporated into Panel Proposal 13-18. Only editorial revisions were made to the text.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 811

13- 20 - (450-23 and 450-23, FPN): Accept in Principle
SUBMITTER: Gerald E. Lingenfelter, American Insurance Association
RECOMMENDATION: Revise 1st paragraph of Section 450-23 and 1st line of fine print note to read:

"450-23. High Fire Point Liquid - Insulated Transformers. Transformers insulated with less-flammable liquids shall be permitted to be installed without a vault in occupancy areas containing only noncombustible materials in buildings of Type I or Type II construction, provided...."

1st line of FPN - "For definitions of "noncombustible material" and "Type I" and "Type II" construction, see Types of Building Construction, NFPA 220-1979."
SUBSTANTIATION: The provisions of NFPA 220-1979 do not define "noncombustible" as the term is used in this section. NFPA 220 does define "noncombustible material" and provides definitions of various standard types of building construction ("noncombustible buildings" is not included). We propose wording which is consistent with NFPA 220-1979 and, we believe, with the committee's intent. (Note: This proposal will have to be coordinated with the TIA wording which will also be proposed for this section.)
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal was accepted in its entirety and incorporated into Panel Proposal 13-18. Only editorial revisions were made to the text.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1557

13- 21 - (450-23): Accept in Principle
SUBMITTER: Tor Orbeck, Dow Corning Corporation
RECOMMENDATION: Proposed new text for Section 450-23.
450-23. Less Flammable Liquid-Insulated Transformers. Transformers insulated with listed less flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings.

Such indoor transformer installations not meeting the clearance requirements of liquid listing or in combustible buildings or combustible occupancy area, shall be provided with an automatic fire extinguishing system or shall be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall be safeguarded with respect to combustible materials in accordance with Section 450-27.

For the purpose of this section, a less flammable liquid is one with a listed fire point and a heat release rate value that is related to the clearance requirements established in the liquid listing.

For definition of "Noncombustible," as used in this section, see NFPA 220-1979, Types of Building Construction.

See definition of "Listed" in Article 100.

SUBSTANTIATION: The fire hazard of an insulating fluid such as a transformer liquid is directly related to its use environment in specific transformer installations. The fire point is a flammability characteristic of a fluid and cannot alone provide adequate information to assess the fire risk for a fluid in a transformer. The existing FMR listing of insulating fluids relates to flammability characteristics such as fire point and heat release rate (of a specified large pool fire test) to the use environment of transformers in noncombustible buildings and noncombustible occupancy, and thereby assesses the total fire risk.

It is, therefore, in Section 450-23, necessary to eliminate the term high fire point liquid and redefine the term less flammable liquids, as shown in the proposed text.
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal was accepted in its entirety and incorporated into Panel Proposal 13-18 with editorial revisions. Specific restrictions to a particular listing such as clearance and heat release rate, were omitted to recognize that other listings of like materials may have different restrictions.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 177

13- 22 - (450-23): Accept in Principle
SUBMITTER: National Fire Protection Association
RECOMMENDATION: Revise 450-23 as follows:
450-23. High Fire Point Liquid-Insulated Transformers. Transformers insulated with less-flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings, provided there is a liquid confinement area and the liquid is listed as having a fire point of not less than 300°C.

Such indoor transformer installations in combustible buildings or combustible occupancy areas, shall be provided with an automatic fire extinguishing system or shall be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall comply with Section 450-27."

(FPN) For definition of "Noncombustible" as used in this section, see Types of Building Construction, NFPA 220-1979.

(FPN) See definition of "Listed" in Article 100.

SUBSTANTIATION: Issued as Tentative Interim Amendment No. 70-81-1 to the 1981 NATIONAL ELECTRICAL CODE by the NFPA Board of Directors on November 14, 1980, as the result of an appeal by RTE Corp.
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal has been accepted in its entirety and incorporated into Panel Proposal 13-18 with editorial revisions and the addition of substantiative material to better define the installation restrictions.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1510

13- 23 - (450-23): Accept in Principle
SUBMITTER: Jerome A. Norcia, Fluids Division, RTE Corporation
RECOMMENDATION: 450-23. High Fire Point Liquid-Insulated Transformers. Transformers insulated with less-flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings, provided there is a liquid confinement area and the liquid is listed as having a fire point of not less than 300°C.

Such indoor transformer installations in combustible buildings or combustible occupancy areas shall be provided with an automatic fire extinguishing system or shall be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall comply with Section 450-27.

4.3.8 National Electric Code - E. J. Huber (Con't.)

SUBSTANTIATION: a. The above proposal is "identical" to the present Section 450-23 which was the result of revision by FIA 81-1.

b. Substantiation:

i) The proposal has, in effect, been the operative Code section for the specified indoor transformer applications during the last six years; the controlling provision being the 300°C fire point requirement. The 300°C high fire point requirement has proven itself as a satisfactory Code standard since there has been no known increase in indoor transformer fires since high fire point fluids have been substituted for askarel.

ii) The presently existing Section 450-23 is clear in its application, uncomplicated, and not subject to misapplication by persons administering the Code.

iii) Although the heat release rate concept will probably be introduced as a possible Code criterion, it is not a concept meant for codification. Calculations necessary to determine heat release rates are complicated and require a thorough understanding of the principles and technical base involved in order to achieve proper application. Since most Code users are not trained in these principles or technical bases, there is a high probability of misapplication.

iv) Beyond fire point, to assess the fire hazard of a transformer insulating liquid in its transformer application environment, it is well recognized that all of the following flammability characteristics must be considered and evaluated simultaneously:

a) Ease of ignition
b) Fire growth
c) Flame propagation
d) Heat release
e) Extinguishment
f) Oxygen depletion
g) Fire endurance
h) Specific heat
i) Thermal conductivity
j) Autoignition point

Log # 1510 Continued

Any Code section which would use just one of these characteristics as THE sole criterion, to the exclusion of the others, would unreasonably restrict consumers in the selection of high fire point transformer fluids. Any Code section, so revised, would preclude the consumer from selecting, among presently available fluids, those fluids which have both electrical reliability and, considering ALL flammability characteristics, properties which provide greater protection in preventing fires from occurring in the first instance.

PANEL ACTION: Accept in Principle.

PANEL COMMENT: The Panel is cognizant of the fact that a number of different factors might be used in evaluating the ability of a less-flammable insulating liquid to perform its intended function safely.

The substance of the proposal has been accepted in its entirety and incorporated into Panel Proposal 13-18 with editorial revisions and the addition of substantiative material to better define the installation restrictions.

VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1347

13- 24 - (450-24): Reject

SUBMITTER: James G. Bryant, Standard Chlorine Chemical

RECOMMENDATION: "Transformers insulated with nonflammable dielectric fluid installed indoors or outdoors and rated over 25 kVA shall be furnished with a pressure-relief vent. Where installed in a poorly ventilated place, the pressure-relief vent shall be connected to a chimney or flue that will carry vent gases outside the building. Such transformers installed indoors and rated over 35,000 volts shall be installed in a vault. For the purposes of this section, a nonflammable dielectric fluid is a fluid which has no fire point to its boiling point."

SUBSTANTIATION: Because of the size of these transformers and most of the nonflammable fluids are fairly volatile there is now more danger of pressure build up or transformer rupture due to vapor. Most of the fire-resistant fluids have hazardous vapors if confined so, they should be vented to the outside. As for the definition of a nonflammable dielectric fluid, it should not burn up to its boiling point. The flash point should be eliminated in the statement because it is often confused with the pseudo flash point which is not indicative of a fire hazard. The flash point is primarily applicable to petroleum products where the flash precedes the fire point by a few degrees. However, not all chemicals exhibit this same feature so that the flash or pseudo flash are meaningless. The comment on flammability in air should be eliminated because all organic materials are flammable in air.

PANEL ACTION: Reject.

PANEL COMMENT: CMP 13 believes the substantiation fails to offer adequate supporting data to justify acceptance.

VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1935

13- 25 - (450-27): Reject

SUBMITTER: Jerome A. Norcia, Fluids Division, RTE Corporation

RECOMMENDATION: 450-27. Oil-insulated Transformers Installed Outdoors. Combustible material, combustible buildings, and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires originating in oil-insulated transformers installed on roofs, attached to, or adjacent to a building or combustible material.

Space separations, fire-resistant barriers, automatic water spray systems, (high fire point transformer liquids), and enclosures that confine the oil or a ruptured transformer tank are recognized safeguards. One or more of these safeguards shall be applied according to the degree of hazard involved in cases where the transformer installation presents a fire hazard.

Oil enclosures shall be permitted to consist of fire-resistant dikes, curbed areas or basins, or trenches filled with coarse crushed stone. Oil enclosures shall be provided with trapped drains where the exposure and the quantity of oil involved are such that removal of oil is important. Transformers installed on poles or structures or underground shall conform to the National ETectrical Safety Code, ANSI C2-1977.

SUBSTANTIATION: a) The above proposal is the same as the present Section 450-27, plus the addition of the phrase: "high fire point transformer liquids."

b) The "problem" occurs because Section 450-23 directs that "(high fire point) transformers installed outdoors shall comply with Section 450-27." Based on the recently issued FI 81-2, this means that a high fire point liquid (300°C minimum) filled transformer is subject to the same "safeguard" requirements as a mineral oil (150°C) filled transformer installed outdoors, which is unreasonable.

c) The proposal would allow recognition of the fact that a high fire point fluid is one such safeguard in itself. The Code already recognizes this fact in indoor transformer installations: Section 450-23 for high fire point transformers installed indoors makes allowance that in certain applications, the high fire point fluid alone can be used in lieu of sprinklers and/or vaults. This fact becomes even more apparent since in Section 450-26 for oil-insulated transformers installed indoors, a vault is mandatory in all such applications. It is obvious that the difference between these two sections is the recognition of the high fire point fluid's superior fire safeguard properties as compared to mineral oil.

PANEL ACTION: Reject.

PANEL COMMENT: CMP 13 disagrees with the proposer's substantiation. Less-flammable liquid-insulated transformers installed indoors require safeguards according to the degree of fire hazard involved, and it is the intent of CMP 13 to provide comparable safeguards for the installation of such transformers outdoors according to the degree of fire hazard.

See Proposal 13-18.

VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 516

13- 26 - (450-28-(New)): Accept in Principle

SUBMITTER: Robert I. Tudor, High Voltage Maintenance Corp.

RECOMMENDATION: Add new Section 450-28:

450-28. Modification of Transformers. If modifications are made to a transformer in an existing installation which changes the type of the transformer with respect to Part B of this article, the modified transformer installation shall comply with the applicable requirements for that type of transformer.

SUBSTANTIATION: At the present time many transformers are being modified from one type to another. Most of these modifications involve the removal of Askarel and the installation of either oil or a high fire point liquid. This type of modification (retrofill), being performed because of environmental considerations, will probably continue to occur over an extended period of time.

The recommended new Section 450-28 will assure that when such a modification is performed, the resulting installation will have the same degree of safety as if it were a new installation.

As an example, it will prevent the replacement of Askarel with oil in an indoor installation without a vault.

PANEL ACTION: Accept in Principle.

Reword proposal as follows:

450-28 Modification of Transformers. When modifications are made to a transformer in an existing installation which changes the type of the transformer with respect to Part B of this article, such transformer shall be marked to show the type of insulating liquid installed and the modified transformer installation shall comply with the applicable requirements for that type of transformer.

PANEL COMMENT: The Panel feels that the new liquid should be identified.

VOTE ON PANEL ACTION: Unanimously Affirmative.

ARTICLE 460 -- CAPACITORS

Log # 580

13- 27 - (460-7): Accept

SUBMITTER: Warren H. Cook, IEEE

RECOMMENDATION: Delete Section 460-7 in its entirety.

SUBSTANTIATION: The application of capacitors to motor circuits for power factor correction does not constitute an electrical hazard nor a fire hazard when all of the other provisions of Article 460 are adhered to. The sentences in Section 460-7 are design considerations, and do not belong in the Code anymore than does dictating the size of the coupling between a motor and the driven equipment.

PANEL ACTION: Accept

4.3.9 HVACC Subcommittee I

1. Working Group 1A - Chairman A. D. Kline (Southern Transformer Co.)

Document is "Proposed American National Standard Conformance Standard for Dry-Type Transformers Used in Unit Installations, Including Unit Substations." This document was balloted in C57 and comments received are still being reviewed and incorporated into a draft to be reballoted in C57.

2. Working Group 2 - Chairman H. W. Book (Westinghouse)

Document is "American National Standard Conformance Standard for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations Including Unit Substations." This document was published by ANSI as C57.12.27-1982.

3. Working Group 2A - Chairman R. E. Uptegraff, Jr. (R. E. Uptegraff Manufacturing Company)

Document is "American National Standard for Liquid-Filled Transformers, Excluding Pad-Mounted Compartmental-Type Transformers, Used in Unit Installations Including Unit Substations." This document was published by ANSI as C57.12.13-1982.

4. Working Group 11 - Chairman W. R. Goldbach

A HVACC document "Proposed Conformance Tests for Separate Insulated Connectors" was approved by HVACC Subcommittee I and forwarded early this year to ANSI C119 with a recommendation for balloting as publication ANSI C119.2(a) - 198X. It is anticipated that the document will be issued as a supplement to the latest revision of ANSI C119.2.

5. Working Group 14 - Chairman J. H. Keeler (General Electric Company)

Document is "Proposed Addendum to American National Standard for Instrument Transformers C57.13.2." This document was balloted by ANSI C57 and negative ballots are presently being resolved so that the document may be reballoted.

6. Working Group 16A - Chairman G. M. Bell (General Electric Company)

Document is "Proposed American National Standard Conformance Guide for Thermal Evaluation of Dry-Type Ventilated Transformer Insulation Systems." The document has been split into two parts, one covering conformance test requirements and the other covering test procedures. The first section is being handled as an appendix to C57.12.55-198X which is covered by Item 1 above and has accompanied that document in its submittal to C57. The second section is being coordinated with IEEE-65 and has received approval from the IEEE Standards Board. The document has now been forwarded to C57 for publication. It is anticipated that the document will be published as C57.12.56.

4.3.9 HVACC Subcommittee I (Con't.)

7. Working Group 16B - Chairman R. D. Buckley (Westinghouse)

Document is "Proposed American National Standard Conformance Guide for Insulating Systems and Materials for Liquid-Filled Transformers." The document accompanied Items 2 and 2A above as an appendix when sent to HVACC Subcommittee I for balloting, as well as when it was sent to ANSI C57. The document is now included as an appendix in the newly published C57.12.13-1982 and C57.12.27-1982 documents.

5.0 Technical Papers for Future Meetings - L. J. Savio

It was reported that at the 1983 Winter Power Meeting the Transformers Committee had 14 papers but only 7 papers could be accepted due to the paper quotas. Mr. Savio also thanked all reviewers for their work.

A job well done was given by all members to Bill McNutt for his clear and firm leadership as Chairman for the past two years.

6.0 New Business

No new business was brought forth.

The meeting adjourned at 10:30 a.m.

Respectfully submitted,

Dean A. Yannucci
Secretary
IEEE Transformers Committee

ADMINISTRATIVE SUBCOMMITTEE MINUTES

OCTOBER 25, 1982

MINUTES OF ADMINIATRATIVE SUBCOMMITTEE
OCTOBER 25, 1982

MEMBERS PRESENT

W. J. McNutt
B. F. Allen
O. R. Compton
J. C. Dutton
J. K. Easley
R. J. Jacobsen
R. E. Liebich
L. S. McCormick
C. J. McMillen
L. J. Savio
L. R. Smith
R. C. Thomas
D. A. Yannucci

GUESTS PRESENT

P. Bellaschi
J. Bonucchi
[redacted]
G. Evans
F. Huber, IEEE Staff
B. Stanleigh, IEEE Staff
C. White, NEMA Staff
L. B. Wagenaar

I. Attendance and Acknowledgement of Guests

Attendees introduced themselves (see page 1).

II. Chariman's Remarks

G. Evans was introduced as host of the Spring, 1983 Meeting. The tentative agenda was passed out. It was reviewed and modified as noted in Appendix I.

H. Light was introduced as the potential Secretary of the IEEE Transformers Committee.

L. Wagenaar was introduced as the new Chairman of the Bushing Subcommittee replacing J. K. Easley who is retiring.

III. Minutes of March 29, 1982 Meeting

It was noted that pages 12 and 13 were missing in some copies.

IV. Review of PES Standards Coordinating Committee - L. Savio

A PES Standards Coordinating Meeting was held at the Summer Power Meeting which I did not attend. I have received minutes of the meeting. However, other activity is highlighted below:

1) The SCC has advised the IEEE Standards that it recommends no SCC coordinating activity be required for re-affirmation or withdrawal of standards documents.

2) Since January 1, 1982, I have reviewed 16 requests for coordination and we have accepted three for coordination; i.e.,

   a) Guide for Containment of Oil Spills in Substations.

   b) Design Tests for Distribution Surge Arresters

   c) Performance and Testing Specification of HVDC System.

3) We have submitted for project requests to the Standards Board Since January 1, 1982.

The chairman passed out information on the subcommittee's working guide and submittal form to the IEEE Standards Board. This is given in Appendix II.

V. Review of TOD Activities - W. J. McNutt

Report on TOD Activities (W.J. McNutt)

TOD met on Monday evening, July 19, 1982 at the Summer Power Meeting in San Francisco. Items of note are as follows:

1. TOD endorsed the proposed PES reorganization which has been thoroughly communicated throughout the Society recently. Subsequently, at the PES Council meeting on July 22, that body also approved it with minor modifications.

2. A new TOD Publications Committee was approved to deal with policy matters regarding technical paper publication, including allotment of numbers of papers, page limits, page charges, etc. The Technical Paper Coordinator for each Technical Committee would serve on the Publications Committee. Dean Yannucci would be our committee member for 1983-1984.

   Prior to the formation of the new Publications Committee, the PES Publications Department had already made the following decisions:

   (a) 220 papers for 1983 WPM.
   (b) Authors required to pay $80 per page beyond page limit.
   (c) External subscription charge for transactions will be $180.

3. It was voted to abolish the practice of "Blind Peer Review" of technical papers. It will no longer be necessary to remove authors' names before distributing papers for review.

4. The Substations Committee will sponsor a session on "PCB's - Technical Aspects" at the 1983 Summer Power Meeting. The Power System Engineering Committee will develop a technical information paper on the impact of PCB regulations.

5. The IEEE Laboratory Accreditation Program For Nuclear Testing Laboratories has been put on "Hold" by the IEEE Board of Directors. Staff has been instructed to enter into no promotional activities and spend no money. An Ad Hoc committee will study the matter, including the NRC position.

6. TOD approved implementation of a Report of the Task Force on Advanced Electrotechnology Applications to Nuclear Plants. The report will be presented at the 1983 WPM. The principally affected technical committees are Nuclear Power Engineering Committee and Power Generation Committee. Each has been asked to prepare an implementation schedule.

7. A TOD Task Force has prepared a position paper on "Safety and Interconnect Operation of Dispersed Storage and Generation Equipment" which TOD voted to publish.

VI. Review of Standards Project Status - L. R. Smith

All subcommittees except the Audible Sound and Vibration Subcommittee reported up-to-date status of their projects. The status on the projects under the Audible Sound and Vibration Subcommittee will be furnished as an addendum to this report when determined.

Two new projects have been approved:

PC57.104 - ANSI/IEEE Std. C57.104 - Guide for the Detection and Determination of Generated Gases in Oil-Immersed Transformers and Their Relation to the Serviceability of the Equipment

P954 - Guide for Acceptance and Maintenance of High Temperature Hydrocarbon Liquid in Equipment Under Insulation Fluids Subcommittee

Project authorization requests have been submitted for the following proposed projects:

ANSI-C57.21 - Revision of Dielectric Test Requirements for Shunt Reactors Under Dielectric Tests Subcommittee, Revision of Dielectric Tests Working Group

ANSI-C57.93 - Guide for Installation of Liquid-Immersed Power Transformers Under West Coast Subcommittee, Installation Guide Consolidation Working Group.

A task force has been formed to consider action on Trial Use Document 262B (Dielectric Tests of Transformers for Use on Effectively Grounded Systems 345 kV and Above).

In Olin Compton's Performance Characteristics Subcommittee work is progressing on several sections of C57.12.90 and C57.12.00 that I have been unable to identify by project number. The work is listed below by paragraph numbers:

C57.12.90; 8.3.2.1 Voltmeter Connection for No-Load Measurement

Draft #3 of working group ballot being discussed.

C57.12.90; 8.1 & 8.2.2 No-Load Loss Temperature Correction

Draft #2 of working group ballot ready for working group discussion.

C57.12.90; 8.2.1 Awaiting additional data.

C57.12.00; 4.1.6.1 & 4.3.3(10) Rated Load Operation of Tertiary Winding

John Dutton attempting to resolve negative committee ballots.

C57.12.00; 9.1 Ratio Tolerance Requirement.

No progress. We are back at the starting point on this. The work will be reassigned. This was P462D at one time.

Mr. Ron Little has replaced Mr. R. G. Jacobsen as chairman of the West Coast Subcommittee. Mr. Little's address and phone number are:

The Washington Water Power Company
P.O. Box 3727
Spokane, Washington 99220
(509) 489-0500 ext. 2409

My records have the chairmen as listed below:

R. E. Liebich	Audible Sound and Vibration
J. K. Easley	Bushing
L. S. McCormick	Dielectric Tests
B. F. Allen	Dry-Type Transformers
O. R. Compton	Performance Characteristics
H. A. Pearce	Insulating Fluids
C. J. McMillen	Insulation Life
R. C. Thomas	Instrument Transformers
Ron Little	West Coast
L. R. Smith	Standards

The following is a summary of the activities and status of the various subcommittee projects.

Project Status

PC57.12.00 - General Requirement for Liquid-Immersed Distribution Power and Regulating Transformers

Still being discussed in the working group.

PC57.12.01 - General Requirements for Dry-Type Distribution and Power Transformers

Desirable changes related to solid resin-encapsulated coils have been identified. The development of specific proposals is underway.

PC57.18.10 - Semi-Conductor Rectifier Transformer

Working on definitions. Ballot still some time off.

PC57.21 - American National Standard Requirements, Terminology and Test Code for Shunt Reactors

New task force formed, but no progress to date.

PC57.95 - Loading Guide for Regulators

Draft #3 ballot out to working group.

PC57.96 - Guide for Loading Dry-Type Distribution and Power Transformers

The working group continues to consider various changes.

PC57.104 - Guide for the Detection and Determination of Generated Gases in Oil-Immersed Transformers and their Relation to the Serviceability of the Equipment

New project. Will be discussed in October in Philadelphia.

PC57.110 - Harmonic Load Current Heating of Transformers

First draft prepared for ballot. Coordination being accomplished.

PC57.111 - Guide for Acceptance and Maintenance of Silicone Liquid in Equipment

First draft being prepared.

P21 - Revision of ANSI C76.1

No change since March 1982.

P24 - Revision of ANSI C76.2

Stalled in Standards Board office.

P65 - Thermal Evaluation of Ventilated Dry-Type Power and Distribution Transformers

Now being balloted in ANSI C57.

P76 - IEEE Guide for Acceptance and Maintenance of Transformer Askarel in Equipment

Need information on the status of this project.

P93 - Transformer Impulse Tests (C57.98)

Approved by Standards Board.

P262E - Revision of C57.12.90 Loss Tolerances

Ballot D3 sent to full subcommittee to be returned by September 3, 1982. Ballot is on section 9.2.4.2 - Corrections to Load Loss Measurements.

P345 - Review of IEEE Std. 345-1972 Test Procedures for Thermal Evaluation of Oil-Immersed Distribution Transformers (C57.100-1974)

Approved by Transformers Subcommittee and submitted to Standards Board to be acted on at December Board meeting.

P462C - Revision of C57.12.00 Loss Tolerance and Measurements

Working group ballot #2. Ready for discussion.

P513 - Seismic Guide for Power Transformers and Reactors

No change since March 1982 report.

P523 - Guide for the Control of Transformer Sound

No report on progress.

P545 - Recommended Practice for Partial Discharge (Corona) Tests for Transformers

Still being discussed in working group.

P546 - Revision of ANSI Requirements for Instrument Transformers C57.13-1978.

No activity since March 1982.

P637 - Proposed Guide for the Reclamation of Insulating Oil and the Criteria for Its Use

Approved by Standards Board.

P638 - Standard for Type Tests on Class 1E Transformers for Nuclear Power Generating Stations

Attempting to resolve negative ballots on subcommittee Draft #11.

P670 - Switchgear and Transformers Working Group on Instrument Transformers for High-Voltage Circuit Breakers

Subcommittee reports no progress.

P731 - Revision of Guide for Loading Current Limiting Reactors, ANSI C57.99

We now have a chairman for this task force.

P732 - Revision of Current Limiting Reactor Standards, ANSI C57.16

Need information on this working group. Under what subcommittee?

P740 - Dielectric Test Requirements for Power Transformers for Operating at System Voltage from 69 through 230 kV (C57.XX)

Report approved by Standards Board in March but still not published.

P745 - Guide for Conducting a Transient Analysis for Dry-Type Transformers (C57.XX)

Still under discussion in the working group.

P756 - Guide for Loading Transformers Above 100 MVA

Now being balloted in Transformers Subcommittee.

P757 - IEEE Guide for Loading Power Apparatus Bushings

Stalled in Standards Board office.

P784 - Transformer Through Fault Current Duration Guide

Draft #6 currently being balloted.

P785 - Transformers Connected to Generators

Draft #3 ballot results being reviewed.

P786 - Transformer Failure Reporting and Reliability Analysis

Working group ballots due back October 1, 1982.

P799 - Guide for Handling and Disposing of Askarels

There will be an in-depth review of first draft at the meeting in Philadelphia.

P800 - Bushing Application Guide

No progress since March 1982.

P801 - Recommendations for Revisions to ANSI C57.15 Requirements, Terminology, and Test Code for Step-Voltage and Induction-Voltage Regulators

Draft #5 has been balloted in working group with four approved (three with comments) and one not approved. Discussion of these items will be the agenda in Philadelphia.

P832 - Detection and Measurement of Partial Discharge (Corona) in Instrument Transformers

No change reported since March 1982.

P838 - Guide for Performing Overload Heat Runs

Now preparing Draft #6 of this proposed project.

P842 - Loss Evaluation Guide

Draft #5 was presented to West Coast Subcommittee during summer power meeting in San Francisco.

P852 - Bushings to Operate in Gas-Insulated Substation

No progress to report since March 1982.

There are still a few projects which I have been unable to get a handle on:

P670 - Instrument Transformers for High-Voltage Circuit Breakers

Last reported action was mailing of ballot P670/D4 dated September 16, 1980.

P732 - Current Limiting Reactors

Last report was in March 1980 when D. A. Duckett resigned and a new chairman was being sought.

P832 - Partial Discharge in Instrument Transformers

The committee was to investigate to see if this work should be incorporated into C57.13.

If readers of this report note any projects listed that are no longer active or valid and should be removed, or if any active ones are not listed, please let me know so that I can add or delete as necessary. Please furnish P number, title, and relation to IEEE or ANSI Standard.

It was noted that L. Savio was to check the PAR records to determine sponsorship for P732 on current limiting reactors. Also, C. McMillan was to check his records for any background information on this PAR.

Ray Smith also noted a question about current transformer saturation characteristics was given to R. Thomas for Review.

J. Easley asked the IEEE staff to report on the status of P757 Loading Guide for Apparatus Bushings and project 24-1977.

R. Smith acknowledged the fine job Loren Wagenaar performed on the review of the IEEE dictionary.

VII. Review of ANSI Standards Status - J. C. Dutton

ANSI C57 BALLOT NO. IEEE PROJ. NO.	BRIEF DESCRIPTION	IEEE STD BD SUBM.	ANSI C57 COMM SUBM.	ANSI BSR SUBM.	EDIT, TYPESET	PRINTING
348 P733	C57.21 (Shunt Reactors)	C	C	C	C	Printed
349 P547	C57.94 (Dry-Type Rec. Pract.)	C	C	C	C	Printed
353	HVACC, C57.12.55, Dry Type	N/A	Reballot			
354	HVACC, C57.12.27, Dist. Tr.	N/A	C	C	IP	Printed
355	HVACC, C57.12.13, Power Tr.	N/A	C	C	IP	Printed
356	HVACC, C57,13.2, Inst. Tr.	N/A	Reballot			
358	C57.12.24-1982, Dist. Tr.	N/A	IP	C	C	Printed
359	C57.12.40-1982, Dist. Tr.	N/A	IP	C	IP	Printed
	C57.12.14, PT DielTests (Trial Use Document)	C	N/A	N/A	IP	Expected 10/82
	ANSI/IEEE C57.12.56-198X Dry-Type Insul. Testing (Models) (Formerly known as IEEE 65)	C	Balloting			
	ANSI/IEEE C57.98-1982 Impulse Test Guide	C				

Bltg. = Balloting IP = In Process C = Complete N/A = Not Applicable

P. Bellashi inquired about the status of IEEE working group 70.1 on GIS. D. Cash was noted as the Transformers Committee liaison. A document generated by this working group should be sent to the Transformers Committee for review. This document should be sent to J. EAsley and L. Wagenaar. O. Compton volunteered to look into getting this information from working group 70.1 and will provide liaison information replacing D. Cash.

VIII. Subcommittee Activities

The chairman noted that an EEI Committee is working on a guide for "Receiving, Installation and maintenance of Large Power Transformers." N. Melton was coordinating this document. It was noted that the West Coast Subcommittee was working on a similar document. The EEI draft document was given to R. Jacobson for submission to the West Coast Subcommittee. Upon final acceptance of the EEI document, Nick Melton will send a cpy to the West Coast Subcommittee.

O. Compton asked if the West Coast Subcommittee was aware of the EEI work already. L. Savio noted that they were and also indicated that the EEI Committee wanted to include maintenance in their document.

IX. Liaison Representation - W. J. McNutt

The chairman noted the following liaison changes:

1. The new secretary will replace D. A. Yannucci on the Social Implications Committee.

2. L. Long will replace J. Bonucchi on the PES Awards Committee and Recognition Committee.

3. J. W. McGill will replace S. Foster on ANSI C57.21.

4. Ed. Yasuda has replaced Ed Adolphson on C62.

5. P. Bellashi will continue as C92 liaison. All expirations in 1982 will be re-appointed.

L. Savio brought up an EEI letter concerning the status of ANSI being transferred to an accredited organization. F. Huber noted that C57 Committees and Subcommittees do not change.

Liaison reports are as follows:

IEC Technical Committee 14 (Transformers) has been rather dormant since the recent printing of IEC Publication 76-3 1980, Power Transformers Part 3: "Insulation Levels and Dielectric Tests."

Correspondence with the TC-14 Chairman, Mr. F. C. Pratt, indicates that TC-14 is tentatively planning to meet in 1983, but apparently the time and place are not yet determined.

Two newly announced standards (listed in the July 1982 IEC Bulletin) which may be of interest are:

726 (1982) "Dry-Type Transformers"
39 pp. Fr.s. 51.

727 "Evaluation of Electrical Endurance of Electrical Insulation Systems
727-1 (1982) Part 1: General Considerations and Evaluation Procedures Based on Normal Distributions"
31 pp. Fr.s. 40.

(These can be obtained through ANSI.)

For information, the present Members of the IEC TC-14 Technical Advisory Group (TAG) are listed below:

J. C. Dutton - Chairman
C. H. White - Secretary

L. W. Long
R. T. Uptegraff
R. L. Ensign
C. R. Murray
J. C. Dutton
R. B. Stetson
A. C. Wurdack
} ANSI C57

W. J. McNutt
L. J. Savio
D. A. Yannucci
B. F. Allen
J. V. Bonucchi
O. Compton
J. K. Easley
R. E. Liebich
L. S. McCormick
C. J. McMillen
H. A. Pearce
} IEEE

E. R. Uhlig
C. Ludeke
P Hopkinson
} NEMA

The ANSI C57 Committee last convened in April 1982 in Los Angeles following the meeting of the IEEE Transformers Committee. The next meeting is planned in April 1983 in Atlanta, Georgia.

The sheet showing the "Status of IEEE and ANSI C57 Ballots, and Printing" (attached) shows many standards printed. In general, it appears that most transformer standards documents are up-to-date and current, with a few still involved in balloting or printing.

Other ANSI Transformer Documents recently printed include:

ANSI C57.12.20-1981
ANSI C57.12.25-1981
ANSI/IEEE C57.13.1-1981

IEEE Headquarters recently reviewed and revised the IEEE Delegation to compensate for retirements, resignations, etc. The current Delegation includes:

John C. Dutton, Chairman - IEEE Delegation to ANSI C57 (TR)
L. W. Long (TR)
L. S. McCormick (TR)
O. R. Compton (SUB)
J. V. Bonucchi (TR)
E. R. Smith (IPPS)

The current Chairman of the ANSI C57 Committee is L. W. Long, and the Secretary is C. H. White (of NEMA).

ANSI has recently published "Procedures for the Development and Coordination of American National Standards," dated September 1, 1982. It is expected that the new procedures described in this booklet will affect the organization of ANSI Transformer Committees during the next few years.

ANSI C57.12.1 - POWER TRANSFORMERS (D. C. DUTTON)

Work has been in progress to update ANSI C57.12.10-1977 and ANSI C57.12.30-1977, and to combine these in a single document with a goal of eliminating as much duplication as possible.

Meetings were held in Washington, DC, September 22 and 23, 1982 by the NEMA Technical Committee and the ANSI C57.12.1 Power Transformer Subcommittee to review and comment on a draft of this proposal.

Also discussed at these meetings were comments and proposals of Mr. R. Beckwith relative to LTC transformer control standards.

ANSI C57.12.2 - TASK FORCE ON DISTRIBUTION TRANSFORMER PRESSURE RELIEF (C. KAPPELER)

This subcommittee met in St. Louis on October 14, 1982

Standards C57.12.21 and C57.12.22 issued in 1980 and C57.12.20 issued 1981 are being reviewed for revisions. Any desired changes should be directed to the appropriate Working Group Chairman.

Standard C57.12.26, draft X, will be ballotted with goal of being approved before year end.

It has been proposed that a standard be developed for dual voltage and Δ-Y transformers.

The practice of installing transformers on poles in the horizontal position, as well as allowable tilt on both pole and padmounts, were discussed. As this appears to be an installation or application problem, it is requested that this problem be studied and acted upon by IEEE.

ANSI C57.12.4 AND C57.12.5 SUBCOMMITTEES- (J. C. DUTTON)

These Subcommittees working jointly have begun to develop a standard for dry type network transformers.

ANSI C57.13 - INSTRUMENT TRANSFORMERS (R. C. THOMAS)

No Committee meeting.

ANSI C57.15 - VOLTAGE REGULATORS (A. C. WURDACK)

No Committee meeting.

ANSI C62 - SURGE PROTECTIVE DEVICES AND IEEE SPD COMMITTEE (E. J. YASUDA)

Spring 1982 Surge Protective Devices Committee Meeting

The IEEE Surge Protective Devices Committee (SPD) held its Spring 1982 Meeting at the Chase Park Plaza Hotel in St. Louis, Missouri, May 3-7, 1982.

A new Working Group, on Surge Protection for Dispersed Storage Generation System, was established under the Application of Surge Protective Devices Subcommittee. The W.G. scope calls for the review of existing standards, regulations, and codes pertaining to system grounding and surge protection. In the process, evaluate and recommend the adequacy of these documents for application to dispersed storage generation system. The W.G. will also review standards, regulations, and codes being developed by other entities as appropriate.

Parts 1 (Introduction) and 2 (Grounding on Synchronous Generator Systems) of the Neutral Grounding Guide, IEEE 143 are presently being balloted within the Neutral Grounding Devices Subcommittee, chaired by E. R. Taylor, Jr. Other parts of the guide being developed, include Grounding Guide for Auxilliary Systems, Guide for Grounding Distribution Systems, and Guide for Grounding Transmission and Subtransmission Systems.

The SPD negative ballots on the revisions of C62.1 to establish test requirements for the new heavy duty distribution class arresters were resolved. The proposed revisions will be forwarded to the IEEE Standards Board for approval.

The W.G. on Arrester Protection and Coordination - Transformer Insulation did not meet during this meeting. Laboratory test with steep-front current impulses on a transformer (with an arrester) is still being planned at the OB test laboratory. This will validate computer studies which have been performed to obtain the maximum voltage across the transformer winding following arrester operation. The more recent activity of the W.G. related to the review of the proposed revisions to the dielectric test requirements of C57.12.00 and C57.12.90. Comments were submitted to the chairman of the W.G. on Revision of Dielectric Tests.

The metal-oxide surge arrester (MOSA) standard is actively being developed. Draft #5 of th partially completed document is currently being reviewed by the W.G. Concurrent with this activity, the W.G. is actively participating with the corresponding MOSA standard development in IEC.

The Fall 1982 SPD Meeting in Memphis, Tennessee will include a panel discussion on Electrical Protection of CATV. Panel members will be made up from CATV, telephone, electric power utility, and REA representatives. The panel discussion will address such aspects as applicable codes, regulations as well as design considerations an cooperation between CATV, telephone and electrical power utilities.

ANSI C68 - TECHNIQUES FOR DIELECTRIC TESTS (L. S. McCORMICK)

No activity. No report.

ANSI C76 - BUSHINGS (N. J. MELTON)

No activity to report.

ANSI C84 - PREFERRED VOLTAGE RATINGS (J. C. DUTTON)

Work to revise ANSI C84.1 has been completed and (as of 10/13/82) the proposed revision is being considered for final approval by the ANSI Board of Standards Review. It is expected that this revision of ANSI C84.1 will be printed in 1982.

ANSI C89 - SPECIALTY TRASNSFORMERS (S. J. ANTALIS)

1. No ANSI C89 Meetings were held in 1982.

2. Work is going on in NEMA ST-8 Technical Committee to revise NEMA ST-20 (ANSI C89.2) removing references and sections relating to transformers above 600 volts. This will avoid conflict with the new Standards on high voltage published recently (ANSI C57.12.01, C57.12.91, C57.12, 50, 51, 52). This work was approved at the November 1981 NEMA Annual Meeting.

ANSI C92 - INSULATION COORDINATION (J. C. DUTTON)

With the completion of the revisions of ANSI C92.1-1982 and ANSI C92.2-1981, the current work of the C92 Committee appears in good condition. C92.1-1982 is being printed, and C92.2-1982 is printed. ANSI C92 Committee meetings are scheduled in Atlanta December 1 and 2, 1982.

IEEE JOINT COMMITTEE ON NUCLEAR POWER STANDARDS (L. R. STENSLAND)

The IEEE/NPEC/SC-2 met on April 20 and 21, 1982.

1. P600, "Standard for Accreditation of Organizations that Perform Qualification Testing of Equipment for Use in Nuclear Power Generating Stations" - was approved by NPEC.

2. The Working Group on the Qualification of Class 1E Transformers returned comments in August to NPEC/SC-2 on P.323/D.12.

3. The tentative NPEC/SC-2 meeting is scheduled for October 20 and 21, 1982, in Washington, D.C.

IEEE W.G. NO. 70.1 - GAS INSULATED SUBSTATIONS (D. J. CASH)

No report available.

REPORT OF ACTIVITIES IN CIGRE SC-12 TRANSFORMERS

(W.J. McNutt - U.S. Representative to CIGRE SC-12)

A meeting of SC-12 took place in Paris on September 6 in conjunction with the CIGRE 1982 General Session. Plans were set for a Transformer Colloquium to be held in Aachen, Germany in September 1983. Discussion subjects will be:

1. Thermal aspects of transformers.

2. Terminal connections (Bushings)

3. Cores and core steel.

Work in the U.S. and IEC on revised loading guides has stimulated new interest in thermal aspects - loadability, hot spot measurement, temperature limitations. There were suggestions to form a Working Group, but that action was postponed until after the colloquium discussions. One item of note was the fact that direct reading hot spot sensors have been installed in two production transformers in the U.K. These operate on the principle of measuring the vapor pressure of a volatile liquid contained in a capsule buried within the winding. The capsule is made of stainless steel and measures 8 x 2.5 x 50 mm. Sweden also reported experience with fiber optic temperature sensors in a prototype transformer.

The first two colloquium subjects will be carried forward as preferential subjects for the 1984 General Session. In addition, there will be general discussion of "Part Winding Resonances" with invited participation from SC-33. (Overvoltages and Insulation Coordination). The SC-12 Working Group on this latter subject has been reorganized under the direction of Dr. G. Preininger of Austria. Interest is high in that many countries have experienced transformer field failures which they now attribute to excitation of an internal natural frequency by an external oscillatory switching voltage. I was asked to provide the Working Group with data on natural frequencies of transformers of U.S. manufacture, particularly those of shell form construction, and I will be seeking such information in our Working Group.

At the suggestion of the U.S. Technical Committee I raised the question of detection, containment and disposal of PCB compounds as a possible SC-12 Working Group subject. Some interest was shown by representatives from Japan, Australia and Italy, but the conclusion of the group was that the subject was not of general interest to the CIGRE community. The opinion was expressed that allowable PCB limits is more of a political problem than a technical one. It was suggested that the matter be referred to SC-15 (Insulating Materials) by the SC-12 liaison member.

STANDARDS COORDINATION COMMITTEES 4.0 AND 4.1 (M. L. MANNING)

I. Standards Coordinating Committee No. 4
(Insulating Materials and Systems) E.A. Boulter, Chairman, General Electric Co., Lynn, MA 01910 (16 members). Howard Reymers, Secretary, Underwriters Laboratories, 1285 Walt Whitman Road, Melville, NY 11747.

This committee met on February 1, 1982 in New York at IEEE Headquarters, 12 members present, as outlined in my March 31, 1982 report to the Transformer Committee. On April 28, 1982 the Committee had another session in New York with nine members present.

1) IEC 85, by its letter classification of materials, continues to be a source of conflict. Recent Paris discussions amplify disagreement about using temperature classification by letter or number. Germany, Switzerland and the United Kingdom insist on a direct relationship between letter classification and temperature limits. The U.S. and Canada are strongly opposed. The point that, within the U.S. and probably elsewhere, the letter designations are used for different temperature classes in different equipment was made. This was regarded as being a provincial U.S. problem. A proposal was made to introduce a statement following the table which associates the letter designations with temperatures to the effect that this relationship is not "mandatory". With reluctance the members agreed to discuss this concept with their own National Committees.

   The U.S. position is that IEC Publication 85 is not needed. This policy was met with strong resistance from the IEC. It appears that this document will survive despite of U.S. Some thought exists that IEC 85 may perform ultimately a useful function as a parent document to the 216 series of SC 15B and to publications 505, 610, etc., of TC 63. This relationship would not be unlike that of IEEE No. 1 to Nos. 68 and 69.

2) Chairman Al Boulter reviewed the various parts of the proposed revision of IEEE No. 1 "General Principles for Temperature Limits in the Rating of Electrical Equipment".

   Part 1 was deemed acceptable with a recommendation to expand the title to include definitions which will be cleared with the IEEE Dictionary editor.

   Part II, Materials - First draft planned to be circulated by September 30, 1982, with definitions related to Part II planned to be circulated by August 15, 1982.

   Part III, Systems - Mr. P. Alexander's draft was discussed at length with the result that he will review all comments for consistency and will incorporate them in to P1, D2. And, he will separate the section of the document related to Limiting Temperatures for Insulation Systems (Section 3 of the present document) and will develop them into a new Part IV of IEEE No. 1.

STANDARDS COORDINATION COMMITTEES 4.0 AND 4.1 (Cont.) M. L. MANNING

3) Doubling Interval. Considerable discussion took place concerning the doubling interval in Arrhenius plots (proposed as a definition but not used in the body of the text as publication IEC 85; since removed) -- also proposed as an adjunct to TI or RTI in draft revisions of IEC 216-1 (15B/ WG 1 (Lebok - Kelin) 1982-83). Concern was expressed that individuals not familiar with limitations implicit in the doubling interval would attempt to use it to extrapolate to unvalid use temperatures - even if restrictions to its use were to be incorporated into the doubling interval's definition. Considerable opinion, by the group, was that publication of an index related to the slope of the material would provide useful information for comparative purposes to users of materials. The concerned seemed to be allayed somewhat if the doubling interval were to be renamed. Suggestions were made to include index, slope factor, Monsinger index, thermal scaling factor and others. Eventually, it was pointed out that the doubling interval is a concept understood and asserted internationally. A redefinition would probably run into difficulties.

Next Meeting - January 31, 1983 - IEEE Headquarters.

II. Standards Conducting Committee No.4.1. U. S. Technical Advising Group for IEC T-63. E. A. Boulter, Chairman, General Electric Co., Lynn, MA 01912 (26 members) (Secretary to be appointed). For the New York, February 1, 1982 meeting, Mr. J. C. Botts, Westinghouse Electric Co., East Pittsburgh, PA was secretary. This committee has not met since my report for the Los Angeles, CA March 31, 1982 meeting.

Activities of this committee are geared closely to SCC 4.0.

In June 1982, five delegates attended the annual meeting of IEC in Rio de Janerio. At this date, reports are not available. Items on the agenda included the status of IEC TC 63 and the revision of IEC 85. Prior to the annual meeting of IEC, the status of TC 63 is:

a) Meetings of the WGs and committee delegates to be held in Rio de Janerio.

b) Proof copy of the IEC report (27-1) on Electrical Aging has been returned to the central office - will be issued in 1982.

c) U. S. Comments are prepared on 63 (Sec) 47 which include also those of WG 6 of TC 63.

d) The latest 63 secretariat document on multifactor tests has been circulated. 63 (Sec) 48. U. S. Comments are prepared.

e) IEC Publication 85, 15B (Sec) 74 has received many comments and will be submitted.

f) Effort made to convert IEC 610 to a IEEE document, Stds. Project 943 (IEEE Guide for Inclusion of Aging Mechanism Verification and Diagnostic Procedures into Design of Tests for Functional Evaluation of Electrical Insulation Systems).

Next meeting January 1983, IEEE Headquarters.

NATIONAL ELECTRIC CODE (E. J. HUBER)

Attached are copies of pages 246 and 247 of the National Electrical Code Technical Committee Report (preprint of Proposed Amendments for the 1984 NEC). The action proposed for Section 450-23 may be of interest to those involved with liquid-filled transformers employing a "less-flammable" liquid, sometimes called "high fire point" liquid.

If anyone wishes to comment on the proposal for Section 450-23, or any other portion of the preprint, please note that comments should be sent to:

National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269

To be considered at the next Code-making panel meetings, comments must be received by NFPA by November 1, 1982.

13- 18 - (450-23): Accept
SUBMITTER: CMP 13
RECOMMENDATION: 450-23. Less-Flammable Liquid-Insulated Transformers. Transformers insulated with listed less-flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings, provided there is a liquid confinement area, the liquid has a fire point of not less than 300°C, and the installation complies with all restrictions provided for in the listing of the liquid. Such indoor transformer installations not meeting the restrictions of the liquid listing, or installed in combustible buildings or combustible occupancy areas, shall (1) be provided with an automatic fire extinguishing system and a liquid confinement area, or (2) be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall comply with the safeguards of Section 450-27.

(FPN) As used in this Section "Noncombustible" refers to Type I and Type II building construction and noncombustible materials as defined in Types of Building Construction, NFPA 220-1979.

(FPN) See definition of "Listed" in Article 100.
SUBSTANTIATION: This proposal addresses the subject of Proposals 13-19, 13-20, 13-21, 13-22, and 13-23 and in the opinion of CMP 13 provides reasonable safety for the installation of less-flammable liquid-insulated transformers.
PANEL ACTION: Accept.
VOTE ON PANEL ACTION:
AFFIRMATIVE: 11
NEGATIVE: 8oyd.
COMMENT ON VOTE:
HUBER: The terminology "noncombustible" as used in Section 450-23 of the proposal is not strictly correct. NFPA 220 refers to and defines only "combustible" materials. "Occupancies" are defined in NFPA 101 based on the area activity or purpose: such as assembly, educational, health, penal, residential, mercantile, business, industrial, and storage. This should be clarified.
EXPLANATION OF VOTE:
BOYD: In favor of the proposal as a whole but feel that more consideration should be given to the use of the terms "combustible" and "noncombustible."

Log # 97

13- 19 - (450-23): Accept in Principle
SUBMITTER: Ed Fielding, Ed Fielding Electrical Contractor Corp.
RECOMMENDATION: Revise fourth paragraph as follows:
Less-flammable liquid-insulated transformers installed outdoors shall comply with the safeguards of Section 450-27.
SUBSTANTIATION: The reference as presently written is unclear. It could be interpreted that outdoor installations are to be oil-insulated transformers.
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal was accepted in its entirety and incorporated into Panel Proposal 13-18. Only editorial revisions were made to the text.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 811

13- 20 - (450-23 and 450-23, FPN): Accept in Principle
SUBMITTER: Gerald E. Lingenfelter, American Insurance Association
RECOMMENDATION: Revise 1st paragraph of Section 450-23 and 1st line of fine print note to read:

"450-23. High Fire Point Liquid - Insulated Transformers. Transformers insulated with less-flammable liquids shall be permitted to be installed without a vault in occupancy areas containing only noncombustible materials in buildings of Type I or Type II construction, provided...."

1st line of FPN - "For definitions of "noncombustible material" and "Type I" and "Type II" construction, see Types of Building Construction, NFPA 220-1979."
SUBSTANTIATION: The provisions of NFPA 220-1979 do not define "noncombustible" as the term is used in this section. NFPA 220 does define "noncombustible material" and provides definitions of various standard types of building construction ("noncombustible buildings" is not included). We propose wording which is consistent with NFPA 220-1979 and, we believe, with the committee's intent. (Note: This proposal will have to be coordinated with the TIA wording which will also be proposed for this section.)
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal was accepted in its entirety and incorporated into Panel Proposal 13-18. Only editorial revisions were made to the text.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1557

13- 21 - (450-23): Accept in Principle
SUBMITTER: Tor Orbeck, Dow Corning Corporation
RECOMMENDATION: Proposed new text for Section 450-23.

450-23. Less Flammable Liquid-Insulated Transformers. Transformers insulated with listed less flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings.

Such indoor transformer installations not meeting the clearance requirements of liquid listing or in combustible buildings or combustible occupancy area, shall be provided with an automatic fire extinguishing system or shall be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall be safeguarded with respect to combustible materials in accordance with Section 450-27.

For the purpose of this section, a less flammable liquid is one with a listed fire point and a heat release rate value that is related to the clearance requirements established in the liquid listing.

For definition of "Noncombustible," as used in this section, see NFPA 220-1979, Types of Building Construction.

See definition of "Listed" in Article 100.
SUBSTANTIATION: The fire hazard of an insulating fluid such as a transformer liquid is directly related to its use environment in specific transformer installations. The fire point is a flammability characteristic of a fluid and cannot alone provide adequate information to assess the fire risk for a fluid in a transformer. The existing FMR listing of insulating fluids relates to flammability characteristics such as fire point and heat release rate (of a specified large pool fire test) to the use environment of transformers in noncombustible buildings and noncombustible occupancy, and thereby assesses the total fire risk.

It is, therefore, in Section 450-23, necessary to eliminate the term high fire point liquid and redefine the term less flammable liquids, as shown in the proposed text.
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal was accepted in its entirety and incorporated into Panel Proposal 13-18 with editorial revisions. Specific restrictions to a particular listing such as clearance and heat release rate, were omitted to recognize that other listings of like materials may have different restrictions.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 177

13- 22 - (450-23): Accept in Principle
SUBMITTER: National Fire Protection Association
RECOMMENDATION: Revise 450-23 as follows:

450-23. High Fire Point Liquid-Insulated Transformers. Transformers insulated with less-flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings, provided there is a liquid confinement area and the liquid is listed as having a fire point of not less than 300°C.

Such indoor transformer installations in combustible buildings or combustible occupancy areas, shall be provided with an automatic fire extinguishing system or shall be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall comply with Section 450-27."

(FPN) For definition of "Noncombustible" as used in this section, see Types of Building Construction, NFPA 220-1979.

(FPN) See definition of "Listed" in Article 100.
SUBSTANTIATION: Issued as Tentative Interim Amendment No. 70-81-1 to the 1981 NATIONAL ELECTRICAL CODE by the NFPA Board of Directors on November 14, 1980, as the result of an appeal by RTE Corp.
PANEL ACTION: Accept in Principle.
PANEL COMMENT: The substance of the proposal has been accepted in its entirety and incorporated into Panel Proposal 13-18 with editorial revisions and the addition of substantiative material to better define the installation restrictions.
VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1510

13- 23 - (450-23): Accept in Principle
SUBMITTER: Jerome A. Norcia, Fluids Division, RTE Corporation
RECOMMENDATION: 450-23. High Fire Point Liquid-Insulated Transformers. Transformers insulated with less-flammable liquids shall be permitted to be installed without a vault in noncombustible occupancy areas of noncombustible buildings, provided there is a liquid confinement area and the liquid is listed as having a fire point of not less than 300°C.

Such indoor transformer installations in combustible buildings or combustible occupancy areas shall be provided with an automatic fire extinguishing system or shall be installed in a vault complying with Part C of this article.

Transformers installed indoors and rated over 35,000 volts shall be installed in a vault.

Transformers installed outdoors shall comply with Section 450-27.

SUBSTANTIATION: a. The above proposal is "identical" to the present Section 450-23 which was the result of revision by TIA 81-1.

b. Substantiation:

i) The proposal has, in effect, been the operative Code section for the specified indoor transformer applications during the last six years; the controlling provision being the 300°C fire point requirement. The 300°C high fire point requirement has proven itself as a satisfactory Code standard since there has been no known increase in indoor transformer fires since high fire point fluids have been substituted for askarel.

ii) The presently existing Section 450-23 is clear in its application, uncomplicated, and not subject to misapplication by persons administering the Code.

iii) Although the heat release rate concept will probably be introduced as a possible Code criterion, it is not a concept meant for codification. Calculations necessary to determine heat release rates are complicated and require a thorough understanding of the principles and technical base involved in order to achieve proper application. Since most Code users are not trained in these principles or technical bases, there is a high probability of misapplication.

iv) Beyond fire point, to assess the fire hazard of a transformer insulating liquid in its transformer application environment, it is well recognized that all of the following flammability characteristics must be considered and evaluated simultaneously:

a) Ease of ignition
b) Fire growth
c) Flame propagation
d) Heat release
e) Extinguishment
f) Oxygen depletion
g) Fire endurance
h) Specific heat
i) Thermal conductivity
j) Autoignition point

Log # 1510 *Continued*

Any Code section which would use just one of these characteristics as THE sole criterion, to the exclusion of the others, would unreasonably restrict consumers in the selection of high fire point transformer fluids. Any Code section, so revised, would preclude the consumer from selecting, among presently available fluids, those fluids which have both electrical reliability and, considering ALL flammability characteristics, properties which provide greater protection in preventing fires from occurring in the first instance.

PANEL ACTION: Accept in Principle.

PANEL COMMENT: The Panel is cognizant of the fact that a number of different factors might be used in evaluating the ability of a less-flammable insulating liquid to perform its intended function safely.

The substance of the proposal has been accepted in its entirety and incorporated into Panel Proposal 13-18 with editorial revisions and the addition of substantiative material to better define the installation restrictions.

VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1347

13- 24 - (450-24): Reject

SUBMITTER: James G. Bryant, Standard Chlorine Chemical

RECOMMENDATION: "Transformers insulated with nonflammable dielectric fluid installed indoors or outdoors and rated over 25 kVA shall be furnished with a pressure-relief vent. Where installed in a poorly ventilated place, the pressure-relief vent shall be connected to a chimney or flue that will carry vent gases outside the building. Such transformers installed indoors and rated over 35,000 volts shall be installed in a vault. For the purposes of this section, a nonflammable dielectric fluid is a fluid which has no fire point to its boiling point."

SUBSTANTIATION: Because of the size of these transformers and most of the nonflammable fluids are fairly volatile there is now more danger of pressure build up or transformer rupture due to vapor. Most of the fire-resistant fluids have hazardous vapors if confined so, they should be vented to the outside. As for the definition of a nonflammable dielectric fluid, it should not burn up to its boiling point. The flash point should be eliminated in the statement because it is often confused with the pseudo flash point which is not indicative of a fire hazard. The flash point is primarily applicable to petroleum products where the flash precedes the fire point by a few degrees. However, not all chemicals exhibit this same feature so that the flash or pseudo flash are meaningless. The comment on flammability in air should be eliminated because all organic materials are flammable in air.

PANEL ACTION: Reject.

PANEL COMMENT: CMP 13 believes the substantiation fails to offer adequate supporting data to justify acceptance.

VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 1935

13- 25 - (450-27): Reject

SUBMITTER: Jerome A. Norcia, Fluids Division, RTE Corporation

RECOMMENDATION: 450-27. Oil-insulated Transformers Installed Outdoors. Combustible material, combustible buildings, and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires originating in oil-insulated transformers installed on roofs, attached to, or adjacent to a building or combustible material.

Space separations, fire-resistant barriers, automatic water spray systems, (high fire point transformer liquids), and enclosures that confine the oil or a ruptured transformer are recognized safeguards. One or more of these safeguards shall be applied according to the degree of hazard involved in cases where the transformer installation presents a fire hazard.

Oil enclosures shall be permitted to consist of fire-resistant dikes, curbed areas or basins, or trenches filled with coarse crushed stone. Oil enclosures shall be provided with trapped drains where the exposure and the quantity of oil involved are such that removal of oil is important. Transformers installed on poles or structures or underground shall conform to the National Electrical Safety Code, ANSI C2-1977.

SUBSTANTIATION: a) The above proposal is the same as the present Section 450-27, plus the addition of the phrase: "high fire point transformer liquids."

b) The "problem" occurs because Section 450-23 directs that "(high fire point) transformers installed outdoors shall comply with Section 450-27." Based on the recently issued FI 81-2, this means that a high fire point liquid (300°C minimum) filled transformer is subject to the same "safeguard" requirements as a mineral oil (150°C) filled transformer installed outdoors, which is unreasonable.

c) The proposal would allow recognition of the fact that a high fire point fluid is one such safeguard in itself. The Code already recognizes this fact in indoor transformer installations: Section 450-23 for high fire point transformers installed indoors makes allowance that in certain applications, the high fire point fluid alone can be used in lieu of sprinklers and/or vaults. This fact becomes even more apparent since in Section 450-26 for oil-insulated transformers installed indoors, a vault is mandatory in all such applications. It is obvious that the difference between these two sections is the recognition of the high fire point fluid's superior fire safeguard properties as compared to mineral oil.

PANEL ACTION: Reject.

PANEL COMMENT: CMP 13 disagrees with the proposer's substantiation. Less-flammable liquid-insulated transformers installed indoors require safeguards according to the degree of fire hazard involved, and it is the intent of CMP 13 to provide comparable safeguards for the installation of such transformers outdoors according to the degree of fire hazard.

See Proposal 13-18.

VOTE ON PANEL ACTION: Unanimously Affirmative.

Log # 616

13- 26 - (450-28-(New)): Accept in Principle

SUBMITTER: Robert I. Tudor, High Voltage Maintenance Corp.

RECOMMENDATION: Add new Section 450-28:

450-28. Modification of Transformers. If modifications are made to a transformer in an existing installation which changes the type of the transformer with respect to Part B of this article, the modified transformer installation shall comply with the applicable requirements for that type of transformer.

SUBSTANTIATION: At the present time many transformers are being modified from one type to another. Most of these modifications involve the removal of Askarel and the installation of either oil or a high fire point liquid. This type of modification (retrofill), being performed because of environmental considerations, will probably continue to occur over an extended period of time.

The recommended new Section 450-28 will assure that when such a modification is performed, the resulting installation will have the same degree of safety as if it were a new installation.

As an example, it will prevent the replacement of Askarel with oil in an indoor installation without a vault.

PANEL ACTION: Accept in Principle.

Reword proposal as follows:

450-28 Modification of Transformers. When modifications are made to a transformer in an existing installation which changes the type of the transformer with respect to Part B of this article, such transformer shall be marked to show the type of insulating liquid installed and the modified transformer installation shall comply with the applicable requirements for that type of transformer.

PANEL COMMENT: The Panel feels that the new liquid should be identified.

VOTE ON PANEL ACTION: Unanimously Affirmative.

ARTICLE 460 -- CAPACITORS

Log # 680

13- 27 - (460-7): Accept

SUBMITTER: Warren H. Cook, IEEE

RECOMMENDATION: Delete Section 460-7 in its entirety.

SUBSTANTIATION: The application of capacitors to motor circuits for power factor correction does not constitute an electrical hazard nor a fire hazard when all of the other provisions of Article 460 are adhered to. The sentences in Section 460-7 are design considerations, and do not belong in the Code anymore than does dictating the size of the coupling between a motor and the driven equipment.

PANEL ACTION: Accept.

VOTE ON PANEL ACTION: Unanimously Affirmative.

1. Working Group 1A - Chairman A. D. Kline (Southern Transformer Co.)

Document is "Proposed American National Standard Conformance Standard for Dry-Type Transformers Used in Unit Installations, Including Unit Substations." This document was balloted in C57 and comments received are still being reviewed and incorporated into a draft to be reballoted in C57.

2. Working Group 2 - Chairman H. W. Book (Westinghouse)

Document is "American National Standard Conformance Standard for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations Including Unit Substations." This document was published by ANSI as C57.12.27-1982.

3. Working Group 2A - Chairman R. E. Uptegraff, Jr. (R. E. Uptegraff Manufacturing Company)

Document is "American National Standard for Liquid-Filled Transformers, Excluding Pad-Mounted Compartmental-Type Transformers, Used in Unit Installations Including Unit Substations." This document was published by ANSI as C57.12.13-1982.

4. Working Group 11 - Chairman W. R. Goldbach

A HVACC document "Proposed Conformance Tests for Separate Insulated Connectors" was approved by HVACC Subcommittee I and forwarded early this year to ANSI C119 with a recommendation for balloting as publication ANSI C119.2(a) - 198X. It is anticipated that the document will be issued as a supplement to the latest revision of ANSI C119.2.

5. Working Group 14 - Chairman J. H. Keeler (General Electric Company)

Document is "Proposed Addendum to American National Standard for Instrument Transformers C57.13.2." This document was balloted by ANSI C57 and negative ballots are presently being resolved so that the document may be reballoted.

6. Working Group 16A - Chairman G. M. Bell (General Electric Company)

Document is "Proposed American National Standard Conformance Guide for Thermal Evaluation of Dry-Type Ventilated Transformer Insulation Systems." The document has been split into two parts, one covering conformance test requirements and the other covering test procedures. The first section is being handled as an appendix to C57.12.55-198X which is covered by Item 1 above and has accompanied that document in its submittal to C57. The second section is being coordinated with IEEE-65 and has received approval from the IEEE Standards Board. The document has now been forwarded to C57 for publication. It is anticipated that the document will be published as C57.12.56.

7. Working Group 16B - Chairman R. D. Buckley (Westinghouse)

Document is "Proposed American National Standard Conformance Guide for Insulating Systems and Materials for Liquid-Filled Transformers." The document accompanied Items 2 and 2A above as an appendix when sent to HVACC Subcommittee I for balloting, as well as when it was sent to ANSI C57. The document is now included as an appendix in the newly published C57.12.13-1982 and C57.12.27-1982 documents.

X. Power Meeting Papers - L. Savio

The 1982 Summer Power Meeting had 12 papers for review. Six were accepted and six rejected.

For the Winter Power Meeting there were 14 papers to be reviewed. The quota will be 53% to be accepted.

It was noted that it is important to get reviews back with quality responses. This should be passed on to the subcommittees.

It appears for the Winter Power Meeting, there will be two sessions.

XI. Future Transformers Committee Meetings

November 7-9, 1983	Hyatt Regency Dearborn Detroit, MI Host: Mr. D. Cash
April 1-3, 1984	~~Hotel Vancouver~~ Holiday Inn Vancouver, B.C. Host: Mr. G. McRae
Oct. 15-17, 1984	Park Plaza Hotel Boston, MA Host: Mr. R. Minkwitz
Fall, 1985	Toronto, Canada Host: Mr. B. Vietich

Avoid Doble conference

St. Louis

The chairman will inquire of C. Mitchell of Union Electric to determine if he would host the Spring, 1985, meeting.

Spring, 1986 — Little Rock or Pittsburgh

Fall, 1986 — Pittsburgh or Washington

XII. Committee Membership and Nominations

A list of the membership of the Transformers Committee will be attached to the next Transformers Committee minutes.

The following were invited to join the Main Transformers Committee:

L. B. Wagenaar	AEP
G. Chitwood	TVA
J. Ebert	RTE-ASEA
W. Lampe	ASEA
R. Little	Washington Water Power Co.

A format of a computerized membership list was issued to D. A. Yannucci. The formant was explained and it was noted that compatibility of computers could be a serious problem when passed on to future secretaries. It was decided to pursue the program and attempt to load the program on an IBM-DOS system.

XIII. Other Business

The chairman reported that G. Iliff would act as coordinator of the transformer tutorial assuming his company's approval.

The chairman also noted that an article did appear about the Transformers Committee in the PES Review.

It was noted that Jim Harlow was now Working Group Chairman for Step Voltage Regulators.

B. Beckwith's letter concerning his negative ballots concerning LTC control will be forwarded to Jim Harlow.

The chairman passed out a proposed ANSI document C93.4 concerning requirements for power line carrier line tuning equipment. He asked that if anyone has comments, that they be forwarded to D. R. Jernigan. This document is given in Appendix III.

It was noted that R. Smith should follow documents through the IEEE Standards Board. J. Dutton will follow them through C57 and the ANSI Standards Board. R. Smith will include bushing subcommittee documents in his reports.

R. Liebich noted that he had not been affirmed for 51 liaison. The chairman noted this.

A warm "thanks" of appreciation for an excellent job was given by all to the chairman, W. J. Mcnutt.

Respectfully submitted,

D. A. Yannucci
Secretary
IEEE Transformers Committee

APPENDIX I

WORKING COPY II/100682

IEL TRANSFORMERS COMMITTEE MEETING
THE WESTIN PEACHTREE PLAZA HOTEL
ATLANTA, GEORGIA

SUNDAY, April 10, 1983	CHAIRMAN/ACTIVITY	MEETING ROOM
1:00 P.M. - 5:00 P.M.		
T. F. Transformer Reliability	H. G. Light	Tower Room 10
4:00 P.M. - 8:00 P.M.	Registration	Six Flags Foyer
6:30 P.M. - 8:00 P.M.	Reception	Georgian/Confederate Rooms
MONDAY, April 11, 1983		
7:00 A.M. - 8:00 A.M.	Breakfast	French/English Room
7:30 A.M. - Noon	Registration	Six Flags Foyer
8:00 A.M. - 9:50 A.M.		
~~Task Force - Guides For Loading~~	~~D. H. Douglas~~	Confederate Room
W. G. Dielectric Tests For HVDC Stresses Transformers	G. Hurty	Tower Room 6
Insulation Fluids Subcommittee	H. A. Pearce	Tower Room 5
W. G. Loss Tolerances & Measurements	D. S. Takach	Tower Room 7
W. G. Cast Coil Dry-Type Standards	E. J. Huber	Georgian Room TOWER ROOM 4
9:50 A.M. - 10:10 A.M.	Coffee Break	8TH LEVEL BRIDGE
10:10 A.M. - Noon		
W. G. Partial Discharge Tests	H. R. Moore	Georgian Room
W. G. Qualification Of Transformers For Class 1 Nuclear	S. R. Stensland	Tower Room 6
W. G. Dry Type-Dielectric Problems	J. L. Corkran	Tower Room 4
Insulation Fluids Subcommittee	H. A. Pearce	Tower Room 5
W. G. Guides For Loading	R. A. Olsson	Confederate Room
T. F. Semi-Conductor Rectifier Transformers	E. Cham	Tower Room 7
Noon - 1:00 P.M.	Lunch	Unscheduled
1:00 P.M. - 2:50 P.M.		
W. G. Transformer Reliability	H. G. Light	Georgian Room
W. G. Revision Of Dielectric Tests On Distribution Transformers	W. R. Farber	Tower Room 6
W. G. Thermal Tests	R. A. Veitch	Confederate Room
W. G. Dry Type-Thermal Evaluation	G. H. Bowers	Tower Room 4
W. G. Transformers Directly Connected To Generators	D. A. Yannucci	Tower Room 5
T. F. Insulation Level For 1200kV Power Transformers	P. L. Bellaschi	Tower Room 7
2:50 P.M. - 3:10 P.M.	Coffee Break	8th Level Bridge

	CHAIRMAN/ACTIVITY	MEETING ROOM
3:10 P.M. - 5:00 P.M.		
W. G. Revision Of Dielectric Tests	G. W. Iliff	Confederate Room
W. G. Bushing To Operate In Gas Insulated Substations	F. R. Stockum	Tower Room 4
~~W. G. Short Circuit Duration~~ delete	W. F. Griffard	Georgian Room
W. G. Step Type Voltage Regulators	J. H. Harlow	Tower Room 6
W. G. Dry Type - Loading Guide (C57.96)	W. H. Mutschler	Tower Room 5
T. F. Acoustic Detection of Partial Discharges	M. G. Daniels	Tower Room 7
7:00 P.M. - 10:30 P.M.		
Administrative Subcommittee	W. J. McNutt	Tower Room 7
TUESDAY, April 12, 1983		
7:00 A.M. - 8:00 A.M.	Breakfast	French/English Rooms
7:30 A.M. - Noon	Registration	Six Flags Foyer
8:00 A.M. - 10:30 A.M.		
Performance Characteristics Subcommittee	O. Compton	Spanish Room
Bushing Subcommittee	J. K. Easley	Tower Room 4
Insulating Fluids Subcommittee	H. A. Pearce	Tower Room 5
Instrument Transformer Subcommittee	R. C. Thomas	Tower Room 7
Review of 262B	G. W. Iliff	Tower Room 6
10:30 A.M. - 10:45 A.M.	Coffee Break	8th Level Bridge
10:45 A.M. - 1:15 P.M.		
W. G. Thermal Evaluation Of Power And Distribution Transformers	A. C. Wurdack	Tower Room 6
Dielectric Tests Subcommittee	L. S. McCormick	Spanish Room
Audible Sound And Vibration Subcommittee	R. E. Liebich	Tower Room 4
Insulating Fluids Subcommittee	H. A. Pearce	Tower Room 5
Instrument Transformer Subcommittee	R. C. Thomas	Tower Room 7
1:15 P.M. - 2:15 P.M.	Luncheon - General Committee	Confederate/Georgian Rooms
2:15 P.M. - 5:00 P.M.		
West Coast Subcommittee	R. G. Jacobsen	Tower Room 6
Insulation Life Subcommittee	C. J. McMillen	Spanish Room
Dry-Type Transformer Subcommittee	B. F. Allen	Tower Room 5
Instrument Transformer Subcommittee	R. C. Thomas	Tower Room 7 Tower Room 4
WEDNESDAY, April 13, 1983		
7:00 A.M. - 8:00 A.M.	Breakfast	French/English Rooms
8:30 A.M. - 10:00 A.M.		
Transformer Committee	W. J. McNutt	Confederate/Georgian/ Spanish Rooms

APPENDIX II

THE INSTITUTE OF
ELECTRICAL AND
ELECTRONICS
ENGINEERS, INC.

345 EAST 47th STREET, NEW YORK, NEW YORK 10017

(5)

STANDARDS OFFICE

DIRECT NUMBER
(212) [redacted]
705-7864

MAY 4 1982

April 14, 1982

TO: Liaison Representatives to the IEEE Standards Board

FROM: E. Paul Lange, Secretary, RevCom

SUBJECT: 1. SUBMITTER'S WORKING GUIDE

2. SUBMITTAL FORM (Modified)

Effective in 1981 the IEEE Standards Board established the IEEE Standards Review Committee (RevCom) with the following charge

> "Responsible for reviewing proposals for adoption of new and revised standards, and reaffirmation or withdrawal of existing standards to assure that the proposals represent a consensus of parties having a significant interest in the subjects covered."

To facilitate the preparation of a Submittal (and the related documentation), a Submitter's Working Guide has been prepared. Most of the items included in this document are a reflection of questions asked by RevCom members, or actions taken to return a submittal for further clarification.

As the Liaison Representative for your organization you are aware of committee activities directed to the development of a standard or the revision of an existing document. Will you assist the submitter by providing him with a copy of this Guide prior to the completion of the submittal.

The Submittal Form has also been modified to include specific questions detailed in the Standards Manual.

A copy of the Submitter's Working Guide and the current Submittal Form are enclosed. Additional copies may be obtained from the Standards Office.

EPL:dd
Encl.

cc: Members of RevCom (with attachments)

THE INSTITUTE OF
ELECTRICAL AND
ELECTRONICS
ENGINEERS, INC.

345 EAST 47th STREET, NEW YORK, NEW YORK 10017

STANDARDS BOARD

DIRECT NUMBER
(212) 705-7864

IEEE STANDARDS SUBMITTALS

SUBMITTER'S WORKING GUIDE

To assist you in the submittal of a document for consideration and approval as an IEEE Standards Document the following notes have been prepared. (Numbers at the end of paragraphs refer to the applicable section of the IEEE Standards Manual).

1. OPERATING PROCEDURE

1.1. Your document(s), with the Submittal Form and related information, will be distributed to the members of the IEEE Standards Review Committee (RevCom) at least 30 days in advance of the meeting for review and determination of compliance with the procedures detailed in the Standards Manual.

1.1.1 Please provide 30 copies of your Draft Document for distribution.

1.1.2 The cover sheet should include the following statement, in addition to the number and title:

"All rights reserved by the Institute of Electrical and Electronics Engineers, Inc., 345 East 47th Street, New York, N.Y. 10017."

1.2 RevCom will ballot by mail in advance of the meeting. Ballot comments are forwarded immediately to the Submitter for consideration and reply. All documentation, including the replies to the comments, are considered at the meeting.

1.3. RevCom will recommend either approval, or the return of your submittal with a suggestion for additional information or action, prior to recommending approval.

1.4 All RevCom recommendations are transmitted to the IEEE Standards Board for final action. You will be notified of the action taken.

2. CLASSIFICATION OF DOCUMENTS

New Standard | Recommended Practice | Recommended Guide | or Revision
Trial Use Document
Reaffirmations and Withdrawals (See notes below.)

3. SUBMITTAL DOCUMENTATION

3.1 PAR (Standards Project Authorization Request) - Check PAR to be certain that all organizations noted in the PAR have been contacted and their replies noted on the submittal form. Reference should also be made to any other Organization with whom coordination was established by the Sponsor Committee in the course of development of the document. (7.6.3a)

3.2 IEC (International Electrotechnical Commission) - Include a statement indicating IEC documents or current projects which were considered in the development of your document.

The Standards Office can assist you by placing you in contact with the U.S. Technical Advisor who has knowledge of the IEC Activities in your technical area. (7.6.3(d))

3.3 Balloting Committee - Where possible, define makeup of Committee. If not practical, explain on submittal form. (7.6.4)

3.4 Unresolved Negative Ballots - Make every effort to provide a complete written explanation of the action taken by the Sponsor (to answer and accommodate) unresolved negative ballots. If the RevCom ballots indicate the need for a more detailed explanation, the Sponsor will be asked to arrange for a representative to attend the RevCom meeting and provide this explanation. (7.7.2)

4. REAFFIRMATION

4.1 A document submitted for Reaffirmation shall meet the requirements detailed in Section 10.2.1 of the Standards Manual. In addition, RevCom has recommended that the coordination specified in the PAR be notified of the proposed Reaffirmation and be given the opportunity to comment, without vote.

4.2 A document submitted for Reaffirmation will be considered by RevCom as "—still useful and contain no obsolete or erroneous information—" (10.2.1). A statement to this effect should be included with the Submittal Form.

5. WITHDRAWALS

5.1 File a Submittal Form with all pertinent information pertaining to the balloting.

5.2 Consideration should be given to the policy being recommended by RevCom that "an older standard not deemed to meet current technical criteria, but containing information commercially important should not necessarily be withdrawn".

The following statement is a quotation from a policy statement incorporated in all new IEEE Standards:

> "—When a document is more than five years old, and has not been reaffirmed, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art.—"

If you have any questions or desire clarification, please call:

E. Paul Lange 212/705-7864
Secretary
Standards Review Committee

EPL:dd

4/12/82

THE INSTITUTE OF
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345 EAST 47th STREET, NEW YORK, NEW YORK 10017

IEEE STANDARDS BOARD
FORM FOR SUBMITTAL OF PROPOSED STANDARDS

TITLE

Project Number _____

Date: _____

Sponsoring Committee/Society:

Balloting Committee:
(Indicate on reverse the delegation of balloting authority by the sponsor)

Name, Address, & Telephone Number of Submitter

Description of Document

New Revision Reaffirmation Withdrawal - of _____

Standard Recommended Practice Guide Trial Use

BALLOT INFORMATION

Makeup of Balloting Committee (Specify number of members in each category):

Users_____ Producers_____ General Interest _____

Number of Ballots: Sent_____

Returned_____ Percent Returned_____ (75% Required)

Number of Affirmative Votes_____ Percent Affirmative_____(75% Required)

Number of Unresolved Negative Votes_____ Number of Abstentions_____

Please comment on the reverse side on the following:

1. Resolved Negatives (include in the Affirmative Votes): All negative votes have been resolved or substantiation for the position taken by the sponsor has been provided to all voters.
2. Committee members have been given an opportunity to review and reject substantive changes incorporated in response to comments.
3. Unresolved Negatives: Copies of negative votes remaining unresolved at the time of submittal, together with Committee responses must be attached.
4. Comments with Affirmative Votes: Provide information on responses given to these comments.
5. Abstentions: Provide information regarding reasons given for abstentions.

SUBMITTAL FORM (Cont.)

Coordination Acitivity:

Please indicate the responses received from your coordination activities with other Societies, Committees, or outside organizations. Please use the folowing abbreviations:

App = Approved Dis = Not Approved NR = No Response

DP = Declined Participation NObj = No Objection

Committee/Organization	Response	Committee/Organization	Response

Please indicate any unresolved problems from coordination activities:

Please provide the information requested on reverse side.

Submitted by:_____
(Signature and Title)

Please return this form to:

Secretary, IEEE Standards Board
345 East 47th Street
New York, N.Y. 10017
212/644-7960

APPENDIX III

Pass to out for Comments

IEEE POWER ENGINEERING SOCIETY

Please address reply to:
D. R. Jernigan
Chairman, ANSI C93 Committee
Tennessee Valley Authority
409 Chattanooga Bank Building
Chattanooga, Tennessee 37401

October 15, 1982

Mr. W. J. McNutt, Chairman
IEEE Transformers Committee
General Electric Company
100 Woodlawn Avenue
Pittsfield, Massachusetts 01201

Dear Mr. McNutt:

PROPOSED AMERICAN NATIONAL STANDARD C93.4-19XX REQUIREMENTS FOR POWER LINE CARRIER LINE TUNING EQUIPMENT

The IEEE Transformers Committee has previously expressed an interest in being kept informed on the status of work by ANSI C93 Committee on Power Line Carrier Equipment and CCVTs. Enclosed for your information is a copy of Proposed ANSI C93.4-19XX Requirements for Power Line Carrier Line Tuning Equipment, which has been issued to ANSI C93 Committee members for official letter ballot. An earlier draft of this document was sent to your committee for review and comment by my letter of March 23, 1981.

The three IEEE members on the ANSI C93 Committee all represent the Power System Communications Committee and will receive instructions for voting from that committee. If your committee should have any objections to this proposed standard, I will be glad to deal with them before the IEEE ballots are cast. Our schedule is to establish the IEEE position by November 22, 1982.

Very truly yours,

D.R. Jernigan

D. R. Jernigan
Chairman, ANSI C93 Committee

Enclosure
cc: William P. Bartley, Chairman
IEEE Power System Communications Committee

OCT 18 1982

Proposed ANSI C93.4-19XX
Draft: 1/18/80
1/14/81
9/23/81
4/07/82

DRAFT OF PROPOSED

AMERICAN NATIONAL STANDARD

REQUIREMENTS FOR POWER LINE CARRIER LINE TUNING EQUIPMENT

prepared by

AMERICAN NATIONAL STANDARDS COMMITTEE C93

Secretariat:

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

FOREWORD

(This Foreword is not a part of American National Standard Requirements for Power Line Carrier Line Tuning Equipment, C 93.4-19XX)

This document was developed by American National Standards Committee C93 on Power Line Carrier Equipment and Coupling Capacitor Voltage Transformers. During its development the standard received the benefits of a consensus of input from a balanced group representing consumer, producer, and general interest viewpoints. These inputs were harmonized and integrated into the standard in its present, approved form.

Standards Committee C93 was established to coordinate, revise and update the existing documents into an effective group of American National Standards, including this standard for line tuning equipment. A separate standard will be developed to cover each type of equipment described in the Committee's scope.

This standard includes technical definitions, performance ratings, testing methods and manufacturing requirements for line tuning equipment. It is related to American National Standard Requirements for Power Line Carrier Coupling Capacitors C93.1-1981, American National Standard Requirements for Power Line Coupling Capacitor Voltage Transformers C93.2-1976, and American National Standard Requirements for Power Line Carrier Line Traps C93.3-1981.

Suggestions for improvement of this standard will be welcome. They should be sent to the American National Standards Institute, 1430 Broadway, New York, New York 10018.

This standard was processed and approved for submittal to ANSI by American National Standards Committee C93 on Power Line Carrier Equipment and Coupling Capacitor Voltage Transformers. At the time of approval of this standard the C93 Committee consisted of the following members.

D. R. Jernigan, Chairman

John D. Hopkins, Secretary

ORGANIZATION REPRESENTED	NAME OF REPRESENTATIVE
Electric Light and Power Group	J. S. Benton F. A. Fragola J. P. Markey (Alt.)
Institute of Electrical and Electronics Engineers	S. J. Bogdanowicz D. R. Jernigan A. Klopfenstein J. B. Wallace (Alt.)
National Electrical Manufacturers Association	D. R. Beuerle R. Ray W. C. Smith (Alt.) A. Sweetana (Alt.)
U.S. Department of Interior, Bureau of Reclamation	V. B. Nokes, Jr.
U. S. Department of Energy, Western Area Power Administration	C. Y. Mui

PROPOSED AMERICAN NATIONAL STANDARD

REQUIREMENTS FOR POWER LINE CARRIER LINE TUNING EQUIPMENT

ANSI C93.4-198X

1. SCOPE

This standard applies to power line carrier line tuning equipment connected between the coupling capacitor(s) and power line carrier transmitter/receiver terminals or to similar line tuning equipment in a carrier bypass. This equipment provides optimum transmission of carrier frequency energy.

Power line carrier line tuning equipment includes assemblies and components such as: tuning inductor, impedance matching transformer, balancing transformer, tuning capacitor, L-C tuning unit, hybrid, filter, protective unit, and enclosure.

This standard also applies to line tuning equipment used with power line carrier systems operating over power cables.

2. DEFINITIONS

All definitions, except as specifically covered in this standard, shall be in accordance with American National Standard Dictionary of Electrical and Electronics Terms, ANSI/IEEE 100-1977; American National Standard Requirements for Power Line Carrier Coupling Capacitors, C93.1-1981; and American National Standard Requirements for Power Line Carrier Line Traps, C93.3-1981.

Basic Lightning Impulse Insulation Level (BIL)

The electrical strength of insulation expressed in terms of the crest value of a standard lightning impulse having a front time of 1.2 microseconds and a time to half value of 50 microseconds. The tolerance range is 1.2-5.0/40-60 microseconds.

Bypasses

Carrier Bypass

A combination of line tuning equipment and associated coupling capacitors that provides a path for bypassing carrier frequency energy around discontinuities such as power transformers, open circuit breakers or disconnect switches, and power lines of different voltages.

Short Bypass

A bypass using tuning elements and carrier lead-in cable between the coupling capacitors.

Long Bypass

A bypass using a line tuner with each coupling capacitor and with coaxial cable interconnecting the tuners.

Coupling Methods

Phase-to-Ground Coupling - Coupling to a power line between one phase conductor of the line and ground.

Phase-to-Phase Coupling - Coupling to a power line between two phase conductors of the line.

Intercircuit Coupling - Coupling to two power lines between a phase conductor of one line and a phase conductor of the other line.

Three-Phase Coupling - Coupling to all three phases of a power line, usually between the center phase conductor and the two outer phase conductors.

Hybrids

Hybrid - An auxiliary tuning device of ten located in transmitter/receiver enclosures which provides a high degree of electrical isolation between two conjugate ports, (ports 1 and 2, Figure 1) while providing low loss between each of these ports and a third port (port 3) when the fourth port (port 4) terminates in a balancing network. Hybrids provide isolation between transmitters and receivers when frequencies are close together.

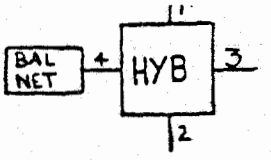


Fig. 1 - HYBRID

Resistive Hybrid - A hybrid with only resistance in the balancing network.

Reactive Hybrid - A hybrid with reactance and resistance in the balancing network.

Skewed Hybrid - A hybrid in which the electrical balance has been altered to give a lower loss than a conventional hybrid in one path (between ports 1 and 3, Figure 1) at the expense of a higher loss in the other path (between ports 2 and 3).

Blocking Capacitor - An optional capacitor connected in series between the line terminal and the impedance matching transformer in the line tuner. This reduces the power frequency current flowing through the impedance matching transformer to prevent saturation while presenting a low impedance to carrier frequency current.

Compensating Capacitor - An optional capacitor connected in series between the line terminal and the tuning inductor unit in the line tuner. This reduces the capacitance of the coupling circuit to facilitate tuning at higher frequencies.

Coaxial Cable - A single conductor with coaxial shield for the low impedance interconnection between a line tuner and the transmitter/receiver or between line tuners for a carrier bypass. Triaxial cable, which has two separate coaxial shields, is also a coaxial type cable.

Carrier Lead-in Cable - An insulated unshielded conductor for the high impedance interconnection between the coupling capacitor and line tuner.

Rated Power Capability - The carrier frequency average power which a line tuner will carry continuously without damage for a specific value of coupling capacitor, frequency range, and line impedance.

Return Loss - A measure of the dissimilarity between two impedances, being equal to the number of decibels that corresponds to the scalar value of the reciprocal of the reflection co-efficient, and hence being expressed by the formula:

$$RL = 20 \log \left| \frac{Z_a + Z_b}{Z_a - Z_b} \right|$$

Where: RL is return loss in decibels and where Z_a and Z_b are the two impedances

Line Tuners

(See Figures Appendix A for Typical Line Tuners)

Line Tuner

An arrangement of elements which, together with one or more associated coupling capacitors, provides the optimum transmission of carrier frequency energy between the power line and the coaxial cable terminal of the line tuner. It also provides a degree of protection for personnel and low-voltage components against the effects of power frequency voltages and transient overvoltages.

Single-Frequency Line Tuner - An adjustable line tuner which is tuned to series resonance with its associated coupling capacitor at one selected carrier frequency.

Two-Frequency Line Tuner - A line tuner which is tuned to series resonance with its associated coupling capacitor at two selected carrier frequencies.

High-Pass Line Tuner - A line tuner which, together with its associated coupling capacitor, forms either an adjustable or fixed high-pass filter in the carrier frequency range.

Band-Pass Line Tuner - A line tuner which, together with its associated coupling capacitor, forms either an adjustable or fixed band-pass filter in the carrier frequency range.

Safety Devices

Protective Unit

A system of components that limit the voltage on the line terminal of the line tuner.

Drain Coil - An inductor in the protective unit connected between the line terminal and the ground terminal of a line tuner, presenting a low impedance to the flow of power frequency current and a high impedance to the flow of carrier frequency current.

Grounding Switch - A switch in the protective unit connected between the line terminal and the ground terminal of a line tuner.

Protective Gap - Spaced electrodes in the protective unit connected between the line terminal and the ground terminal of a line tuner for limiting the voltage impressed between those terminals.

Terminals

Line Terminal - The terminal of the line tuner to be connected to the carrier lead-in cable.

Coaxial Cable Terminal - The terminal of the line tuner to be connected to the coaxial cable.

Ground Terminal - The terminal of the line tuner to be connected to ground.

Tuning Units

Tuning Capacitor Unit - An assembly of fixed capacitors, adjustable in steps.

Tuning Inductor Unit - A continuously adjustable inductor.

Parallel L-C Tuning Unit - An adjustable inductor and capacitor combination, with a selectable inductance-to-capacitance ratio, forming a parallel resonant circuit tuned to present a high impedance at one selected carrier frequency and low impedance at other frequencies.

Series L-C Tuning Unit - An adjustable inductor and capacitor combination, with a selectable inductance-to-capacitance ratio, forming a series resonant circuit tuned to present a low impedance at one selected carrier frequency and high impedance at other frequencies.

Impedance Matching Transformer (IMT) - A transformer which provides fixed or selectable impedance ratios for matching the impedance of the power line to that of the coaxial cable at power line carrier frequencies.

Balancing Transformer - A transformer that divides the carrier frequency power from one source equally into two outputs.

Resonant Frequency - The frequency or frequencies to which the line tuner and its associated capacitor is tuned.

Geometric Mean Frequency (GMF) - For a bandpass line tuner the geometric mean of the bandwidth limit frequencies, which is the square root of their product.

Bandwidth - The frequency range within which the insertion loss is not greater than a specified value.

Tuning Range - The portion of the carrier frequency band through which the geometric mean frequency or resonant frequency may be adjusted.

Insertion Loss - The carrier frequency power loss caused by the combination of the line tuner and associated coupling capacitor(s) (which is assumed to have no loss) terminated by the nominal line side and coaxial cable side impedances.

Nominal Line Side Impedance (Z_1) - The impedance which the line tuner, together with the associated coupling capacitor(s), is designed to match on the line side.

Nominal Coaxial Cable Side Impedance (Z_2)

The impedance which the line tuner is designed to match on the coaxial cable side.

Working Range

The range of carrier frequencies within which the bandwidth of a line tuner can be set.

3. SERVICE CONDITIONS

3.1 Usual Service Conditions

(1) Outdoor service.

(2) Ambient temperature range: -40°C to + 45°C. With regard to the temperature range, Table 1 defines the upper temperature limit conditions.

(3) Relative humidity: 95% at 40°C.

(4) Maximum altitude: 3300 feet (1000 meters) above sea level.

(5) Power frequency: 60 Hz.

(6) Atmosphere free of damaging fumes or excessive or abrasive dust, explosive mixtures of dust or gases, steam, and salt spray.

(7) Carrier frequency range: 30 to 500 kHz.

Table 1

Upper Ambient Temperature Limit Conditions

Maximum Ambient Temperature (°C)		
Mean over 1 Hour	Mean over 24 Hours	Mean over 1 Year
45	40	30

3.2 Unusual Service Conditions

(1) Altitudes above 3300 feet (1000 meters). For line tuning equipment applied at altitudes greater than 3300 feet (1000 meters), the dielectric strength correction factors given in Table 2 shall be applied.

(2) Gas-insulated substations.

Table 2

Dielectric Strength Correction Factors

Altitude above Sea Level		
Feet	Meters	Correction Factor
3,300	1000	1.00
5,000	1500	0.95
10,000	3000	0.80

4. RATINGS

4.1 Protective Unit

4.1.1 Protective Gap Sparkover

The protective gap sparkover shall be no less than 2.0 kV rms at power frequency nor greater than 85% of the line tuner BIL at a standard impulse wave of 1.2/50 microseconds.

4.1.2 Drain Coil Insertion Loss Power Frequency Impedance and Insulation Level

The increased insertion loss due to the addition of the drain coil to the line tuner cannot be standardized because of wide variations in the type of tuner, carrier frequencies, capacitance of coupling capacitor and line side impedance. However, the insertion loss should be the least possible compatible with the bandwidth and design requirements, and generally not greater than .5 dB over the bandwidth of the line tuner.

The impedance of the drain coil at power frequency shall not exceed 60 ohms.

The basic lightning impulse insulation level (BIL) of the drain coil shall be a minimum of 10 kV at a standard impulse wave of 1.2/50 microseconds.

4.2 Insulation Level of Line Tuner

4.2.1 Power Frequency Level

The insulation level between windings of the impedance matching transformer and between circuit to enclosure of the line tuner shall be a minimum of 3.0 kV rms for one minute at power frequency.

4.2.2 Impulse Level

The basic lightning impulse insulation level (BIL) of the line tuner shall be a minimum of 10 kV at a standard impulse wave of 1.2/50 microseconds.

4.3 Insulation Level of Equipment External to Line Tuner

Equipment external to the line tuner on the coaxial cable side shall withstand a power frequency voltage of 1.5 kV for one minute between terminals and chassis.

4.4 Nominal Line Side Impedance

4.4.1 Overhead Power Lines*

The nominal line side impedance of the line tuner shall be within the range of 200 to 400 ohms for phase-to-ground coupling and in the range of 400 to 700 ohms for phase-to-phase coupling. The nominal line side impedance for intercircuit coupling and for 3-phase coupling shall be within the range of 200 to 400 ohms phase-to-ground for each coupled phase.

4.4.2 Underground Power Cables*

The nominal line side impedance of the line tuner shall be within the range of 15 to 50 ohms for phase-to-ground coupling, and in the range of 30 to 100 ohms for phase-to-phase coupling.

* NOTE: These ranges of impedance are derived from the parallel combination of the most common line trap and line impedances.

4.5 Nominal Coaxial Cable Side Impedance

The nominal coaxial cable side impedance of the line tuner shall be 50 or 75 ohms unbalanced.

4.6 Insertion Loss

The insertion loss of a line tuner cannot be standardized because of wide variations in the type of tuner, carrier frequencies, capacitance of coupling capacitor and line side impedance. However, the insertion loss should be the least possible compatible with the bandwidth and design requirements, and generally not greater than 2.0dB over the bandwidth of the line tuner.

4.7 Return Loss

The line side and coaxial cable side return losses should exceed 10 dB over the bandwidth of the line tuner.

4.8 Rated Power Capability

The rated power capability of the line tuner shall be that for which the unit has been designed, compatible with meeting all the other requirements of this standard.

4.9 Harmonic Distortion and Intermodulation

The level of individual harmonic distortion and intermodulation products generated within the line tuner shall be at least 60 dB below the level corresponding to rated power capability.

4.10 Tuning

4.10.1 Types

The types of tuning for line tuners shall be as follows:

TABLE 3 - MINIMUM WORKING RANGES

TYPE OF TUNING	WORKING RANGE (kHz)	COUPLING CAPACITOR RATED CAPACITANCE (uF)
Single-frequency	30 - 90 70 - 200 100 - 300 200 - 500	.001 - .01
Two-frequency	30 - 90 70 - 200 100 - 300 200 - 500	.001 - .01
High-pass	* - 500	.003 - .01
Band-pass	30 - 90 70 - 200 100 - 300 200 - 500	.003 - .01

*NOTE: Low frequency limit depends on line impedance and coupling capacitor capacitance.

A. Single-frequency
B. Two-frequency
C. High-pass
D. Band-pass

4.10.2 Working Ranges

Working ranges for line tuners are given in Table 3.

4.10.3 Frequency Separation of a Two-Frequency Line Tuner

For a two-frequency line tuner, the frequencies shall be separated by at least 25 kHz or 25% of the higher frequency, whichever is greater.

4.10.4 Precision of Tuning

A single- or two-frequency line tuner shall be capable of being tuned to a selected frequency or frequencies within the specified range with an accuracy of ± 0.5%.

4.10.5 Variation of Tuning With Change in Ambient Temperature

A. Single- and Two-Frequency Tuning

The resonant frequency shall not vary more than a total of 2% for changes in ambient temperature within the range of -40°C to +45°C.

B. High-pass Tuning

The low frequency limit shall not vary more than a total of 2% for changes in ambient temperature within the range of -40°C and +45°C.

C. Band-pass Tuning

The GMF shall not vary more than a total of 2% for changes in ambient temperature within the range of -40°C and +45°C.

5. TESTING

5.1 General

5.1.1 Test Conditions

(1) The ambient temperature range for testing shall be from +10°C through +40°C, with +20°C as the reference temperature.

(2) Line tuning equipment for application at an unusual altitude service may be tested at any altitude less than 3300 feet (1,000 meters).

(3) Line tuning equipment for application at an usual altitude service may be tested at any altitude higher than 3300 feet (1,000 meters) if an appropriate altitude correction factor from Table 2 is applied.

(4) The test units shall be new and in clean, dry condition.

(5) The sequence of testing shall be optional, except where otherwise noted.

5.1.2 Production Tests

The following production tests shall be performed by the manufacturer on each line tuner, or equipment external to the line tuner, as specified.

(1) Carrier Protective Gap Setting (5.2.1)
(2) Insulation Level (5.2.2)
(3) Insertion Loss (5.2.3)

5.1.3 Design Tests

The following design tests shall be performed by the manufacturer on each line tuner design and each external equipment design to insure that their characteristics and performance meet the requirements of this standard as specified.

(1) Protective Gap Sparkover (5.3.1)
(2) Drain Coil Insertion Loss, Power Frequency Impedance, and Insulation Level (5.3.2
(3) Insulation Level (5.3.3)
(4) Insertion Loss (5.3.4)
(5) Return Loss (5.3.5)
  (a) Coaxial cable side
  (b) Line side
(6) Rated Power Capability (5.3.6)
(7) Harmonic Distortion (5.3.7)
(8) Intermodulation (5.3.8)
(9) Tuning Stability (5.3.9)

5.2 Production Test Procedures of Equipment

5.2.1 Protective Gap Setting

The protective gap sparkover rating shall be verified by application of power frequency voltage and impulse voltage to the gap and shall be in accordance with 4.1.1. Alternatively the gap setting having been established by test may be verified by mechanical gauging.

5.2.2 Insulation Level Of Equipment

5.2.2.1 Insulation Level of Line Tuner

Every line tuner shall be subjected to power frequency withstand tests and shall meet the requirements of 4.2.1.

The tests shall be performed in the manner outlined in 5.3.3.1 (A) and (B).

5.2.2.2 Insulation Level of Equipment External To Line Tuner

All equipment used in coupling the carrier frequency energy between the transmitter/receiver and the line tuner shall be subjected to a power frequency withstand test in accordance with 4.3.

5.2.3 Insertion Loss

This insertion loss of each line tuner shall be measured in accordance with the method in 5.3.4 using a value of capacitance (C_c) within the rated range.

A. For single-frequency and two-frequency line tuners, measurements shall be made at a resonant frequency(s) within the working range.

B. For high-pass line tuners, measurements shall be made at a frequency near cut-off and at twice the cut-off frequency.

C. For band-pass line tuners, measurements shall be made at a GMF within the working range and at the associated bandwidth limit frequencies.

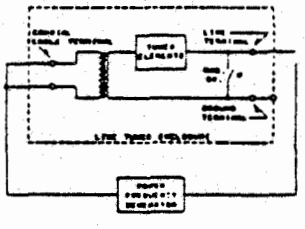


FIGURE 2a

POWER FREQUENCY INSULATION TEST CIRCUIT - WINDING TO WINDING

5.3 Design Test Procedures

5.3.1 Protective Gap Sparkover

The protective gap sparkover setting shall be established by application of power frequency voltage and by application of standard 1.2/50 micro-second impulse voltage to the gap and shall be in accordance with 4.1.1. The gap dimension shall be recorded (ref. 5.2.1).

5.3.2 Drain Coil Insertion Loss, Power Frequency Impedance, and Insulation Level

5.3.2.1 Drain coil insertion loss tests shall be performed in a similar manner and at the frequencies used in the insertion loss tests, 5.3.4.

Insertion loss of the drain coil shall be determined by measurement of the voltage across the test termination resistor, with and without the drain coil in the circuit and shall meet the requirements of 4.1.2.

5.3.2.2 Drain coil impedance shall be measured at power frequency and shall meet the requirements of 4.1.2.

5.3.2.3 Drain coil insulation level shall be tested by application of impulse voltage in accordance with 4.1.2.

5.3.3 Insulation Level

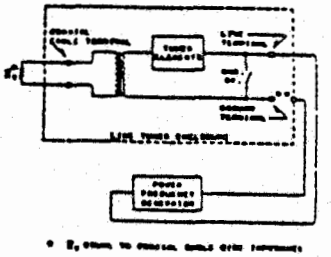
5.3.3.1 Insulation Level of Line Tuner

The insulation level of the assembled line tuner shall be verified by application of power frequency voltage and impulse voltage in accordance with 4.2.

A. To test transformer winding-to-winding insulation the power frequency test voltage shall be applied between the line terminal and the coaxial cable terminal as shown in Figure 2a. For phase-to-phase line tuners, the power frequency test voltage shall be applied with both line terminals connected together.

B. To test circuit elements to enclosure insulation the power frequency test voltage shall be applied between the circuit and the enclosure as shown in Figure 2b. For phase-to-phase line tuners, the power frequency test voltage shall be applied with both line terminals connected together.

C. The standard 1.2/50 micro-second impulse test voltage shall be applied to the line terminal in accordance with the diagram in Figure 3. For phase-to-phase line tuners, the test voltage shall be applied to each line terminal separately. The protective gap shall be disconnected for this test.



A series of 5 positive and 5 negative impulse voltage waves shall be applied to the line terminal of the line tuner. Successful completion shall be determined by the absence of visible flashover and no change in insertion loss as measured before and after this test.

In general, this test shall be performed in accordance with American National Standards Measurements of Voltage in Dielectric Test C68.1-1969 (IEEE Std. 4-1969).

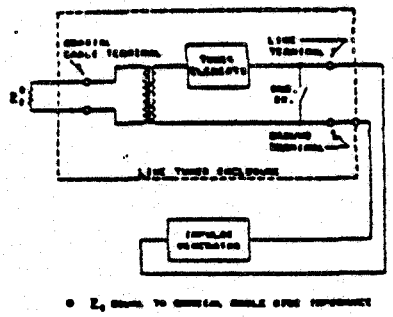


FIGURE 3

IMPULSE INSULATION TEST

5.3.3.2 Insulation Level of Equipment External to Line Tuner

The insulation level of equipment used in coupling of the carrier frequency energy between the transmitter/receiver and the line tuner shall be verified by a power frequency withstand test in accordance with 4.3.

The voltage shall be applied simultaneously between all terminals and the chassis.

5.3.4 Insertion Loss

For the insertion loss test, the coupling capacitor(C_c) shall be replaced by a capacitor having negligible loss and having a capacitance equal to the rated capacitance of the coupling capacitor. If present, the drain coil shall be disconnected for this test. Figure 4 shows one method of measuring the insertion loss, which is given by the equation:

$$IL = 20 \log \frac{V_o}{2V} + 10 \log \frac{Z_1}{Z_2}$$

Where: IL is insertion loss in decibels and where Z_2 and Z_1 are the nominal coaxial cable side impedance and nominal line side impedance respectively. Z_1 shall be a 300 ohm (30 ohms for cable units) non-inductive resistor for a phase-to-ground line tuner and a 600 ohm (60 ohms for cable units) non inductive resistor for a phase-to-phase line tuner. Z_2 shall be a non-inductive resistor whose value is equal to the coaxial cable side impedance. V_o shall be held constant for all frequencies during a given test.

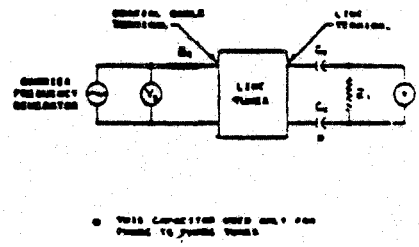


FIGURE 4
Measurement of Insertion Loss

A. Single-Frequency Line Tuner

The insertion loss shall be measured at the resonant frequency. The test shall be performed at the upper, middle and lower frequency of each working range and with the minimum and maximum rated capacitance of the coupling capacitor intended for use within that working range as shown in Table 3.

B. Two-Frequency Line Tuner

The insertion loss shall be measured at each resonant frequency. The test shall be performed at the extremes of each working range and with the minimum and maximum rated capacitance of the coupling capacitor intended for use within that working range as shown in Table 3.

For the test performed at the lowest frequency of the range, the second frequency shall be spaced so that the lower frequency is 25% (or 25 kHz, whichever is greater) lower than the upper frequency. For the test performed at the highest frequency of the range, the second frequency shall be spaced so that the lower frequency is 25% (or 25 kHz, whichever is greater) lower than the upper frequency.

C. High-Pass Line Tuner

The insertion loss shall be measured from the maximum carrier frequency to a frequency where the insertion loss is 3 dB greater than the minimum insertion loss in the pass-band. The test shall be performed with the minimum and maximum rated capacitance of the coupling capacitor as shown in Table 3.

D. Band-Pass Line Tuner

The insertion loss shall be measured between the frequencies where the loss is 3 dB greater than the insertion loss at the GMF. The test shall be performed at the upper, middle and lower GMF of each rated working range, and with the minimum and maximum rated capacitance of the coupling capacitor intended for use within that working range as shown in Table 3.

5.3.5 Return Loss

For the return loss tests, the coupling capacitor (C_c) shall be replaced by a capacitor having a negligible loss and having a capacitance equal to the rated capacitance of the coupling capacitor. Figures 5a and 5b show one method of measuring the return loss which is given by the equation:

$$20 \log \left(\frac{V_1}{V_2} \right) (dB)$$

Where V_1 and V_2 are the voltages measured by voltmeter V with the switch S in the open and closed positions respectively, with the voltmeter V being kept at equal levels in both switch positions.

Z_2 and Z_1 are equal to the nominal coaxial cable side impedance and nominal line side impedance respectively. Z_1 shall be a 300 ohm (30 ohms for cable units) non-inductive resistor for a phase-to-ground line tuner and a 600 ohm (60 ohms for cable units) non inductive resistor for a a phase-to-phase line tuner. Z_2 shall be a non-inductive resistor whose value is equal to the coaxial cable side impedance. Resistor values shall have ±1 percent tolerance.

A. Single-Frequency Line Tuner

The return loss shall be measured at the resonant frequency. The test shall be performed at the upper, middle and lower frequency of each working range and with the minimum and maximum rated capacitance of the coupling capacitor intended for use within that working range as shown in Table 3.

B. Two-Frequency Line Tuner

The return loss shall be measured at each resonant frequency. The test shall be performed at the extremes of each working range and with the minimum and maximum rated capacitance of the coupling capacitor intended for use within that working range as shown in Table 3.

For the test performed at the lowest frequency of the range, the second frequency shall be spaced so that the lower frequency is 25% (or 25 kHz, whichever is greater) lower than the upper frequency. For the test performed at the highest frequency of the range, the second frequency shall be spaced so that the lower frequency is 25% (or 25 kHz, whichever is greater) lower than the upper frequency.

C. High-Pass Line Tuner

The return loss shall be measured over the frequency limits as determined and with capacitance values as specified in 5.3.4 (C).

D. Band-Pass Line Tuner

The return loss shall be measured over the frequency limits as determined and with capacitance values as specified in 5.3.4 (D).

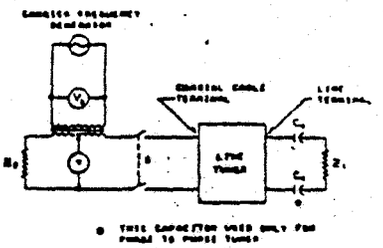


FIGURE 5a
Measurement of Return Loss on Coaxial Cable Side

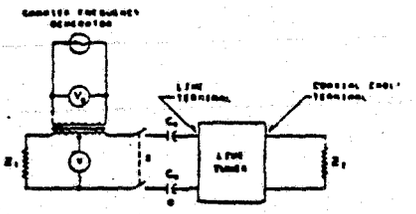


FIGURE 5b

Measurement of Return Loss on Line Side

5.3.6 Rated Power Capability

The rated power capability of the line tuner shall be demonstrated by applying rated power to the coaxial cable side. The rated temperature of the individual components shall not be exceeded and the line tuner shall fully meet all requirements as outlined in this standard at maximum ambient temperature.

For this test, the coupling capacitor shall be replaced by a capacitor (C_c) having negligible loss and having a capacitance equal to the rated capacitance of the coupling capacitor.

The value of the line side impedance shall be a 300 ohm (30 ohm for cable units) non-inductive resistor for a phase-to-ground line tuner and a 600 ohm (60 ohm for cable units) non-inductive resistor for a phase-to-phase line tuner.

The test shall be performed at the frequencies and with the coupling capacitor values as described in 5.3.4.

Power rating tests may be made at any altitude if temperature rise is corrected to usual conditions as indicated in Table 4.

5.3.7 Harmonic Distortion

An rms voltage corresponding to the rated power capability of the line tuner, and whose frequency is within the pass-band of the tuner, shall be applied to the coaxial cable side. Any harmonic distortion component present at the line side of the line tuner shall meet the requirements of 4.9.

For this test, the coupling capacitor shall be replaced by a capacitor (C_c) having negligible loss and having a capacitance equal to the rated capacitance of the coupling capacitor.

The value of the line side impedance shall be a 300 ohm (30 ohm for cable units) non-inductive resistor for a phase-to-ground line tuner and a 600 ohm (60 ohm for cable units) non-inductive resistor for a phase-to-phase line tuner.

The test shall be performed at the frequencies and with the coupling capacitor values as described in 5.3.4.

A. For single-frequency and two frequency line tuners, the resonant frequency(s) shall be applied.

B. For high-pass line tuners, a frequency two times the low frequency limit determined in 5.3.4 (C) shall be applied.

C. For band-pass line tuners, the GMF frequency shall be applied.

5.3.8 Intermodulation

Two test voltages, each equal to one-half the rms voltage corresponding to the rated power capability of the line tuner, and whose frequencies are within the pass-band of the tuner shall be applied to the coaxial cable side. Any individual intermodulation product present at the line side of the line tuner shall meet the requirements of 4.9.

For this test, the coupling capacitor shall be replaced by a capacitor (C_c) having negligible loss and having a capacitance of the coupling capacitor.

The value of the line side impedance shall be a 300 ohm (30 ohm for cable units) non-inductive resistor for a phase-to-ground line tuner and a 600 ohm (60 ohm for cable units) non-inductive resistor for a phase-to-phase line tuner.

The test shall be performed at the frequencies and with the coupling capacitor values as described in 5.3.4.

The intermodulation tests shall be applied to high-pass and band-pass line tuners only.

A. For high-pass line tuners, the frequencies at 1.9 and 2.0 times the low frequency limit determined in 5.3.4 (C) shall be applied.

B. For band-pass line tuners, the frequencies 2 percent above and below the GMF shall be applied.

5.3.9 Variation of Tuning with Change in Ambient Temperature

The variation in the resonant frequency(s) of a single-frequency or a two-frequency line tuner, the GMF of a band-pass line tuner, or the lower frequency limit of a high-pass line tuner shall be determined over the whole of the ambient temperature range of -40°C to +45°C.

For the tuner stability test, the coupling capacitor(s) shall be replaced by a capacitor (C_c) having negligible loss and having a capacitance equal to the rated capacitance of the coupling capacitor. This capacitor (C_c) shall be located outside the environmental test facility for this test.

The resulting variation of tuning shall meet the requirements of 4.10.5 and shall be calculated by using the equation:

$$\text{Variation in Percent} = \frac{f_h - f_l}{1/2\,(f_h + f_l)} \times 100$$

where f_h = highest frequency measured
and f_l = lowest frequency measured

6.0 MANUFACTURING REQUIREMENTS

6.1 Enclosure

The assembled line tuning elements shall be housed in an enclosure suitable for outdoor use. The manufacturer shall designate the type of enclosure in accordance with NEMA Stds. Pub. ICS 1-110.

6.2 Nameplate Markings

A nameplate shall be attached to each enclosure and shall list the following minimum information:

(1) Manufacturer's Name
(2) Type Designation
(3) Serial or Identification Number
(4) Rated Power Capability
(5) Coupling Capacitor Capacitance Range
(6) Nominal Line Side and Coaxial Cable Side Impedances
(7) Carrier Working Range
(8) Type of Tuning

6.3 Safety Devices

6.3.1 Grounding Switch

A grounding switch which may be used to short circuit the carrier lead-in from the coupling capacitor shall be provided and be connected between the line terminal and ground terminal.

6.3.2 Protective Gap

A protective gap shall be provided between the line terminal and ground terminal to limit voltage surges.

6.3.3 Line Tuner Ground Terminal

A ground terminal shall be provided on the external surface of the line tuner enclosure to give the user a convenient grounding means. The tuner circuit ground shall be connected to this terminal.

7. Revision of American National Standards Referred to in This Document

To be supplied later:

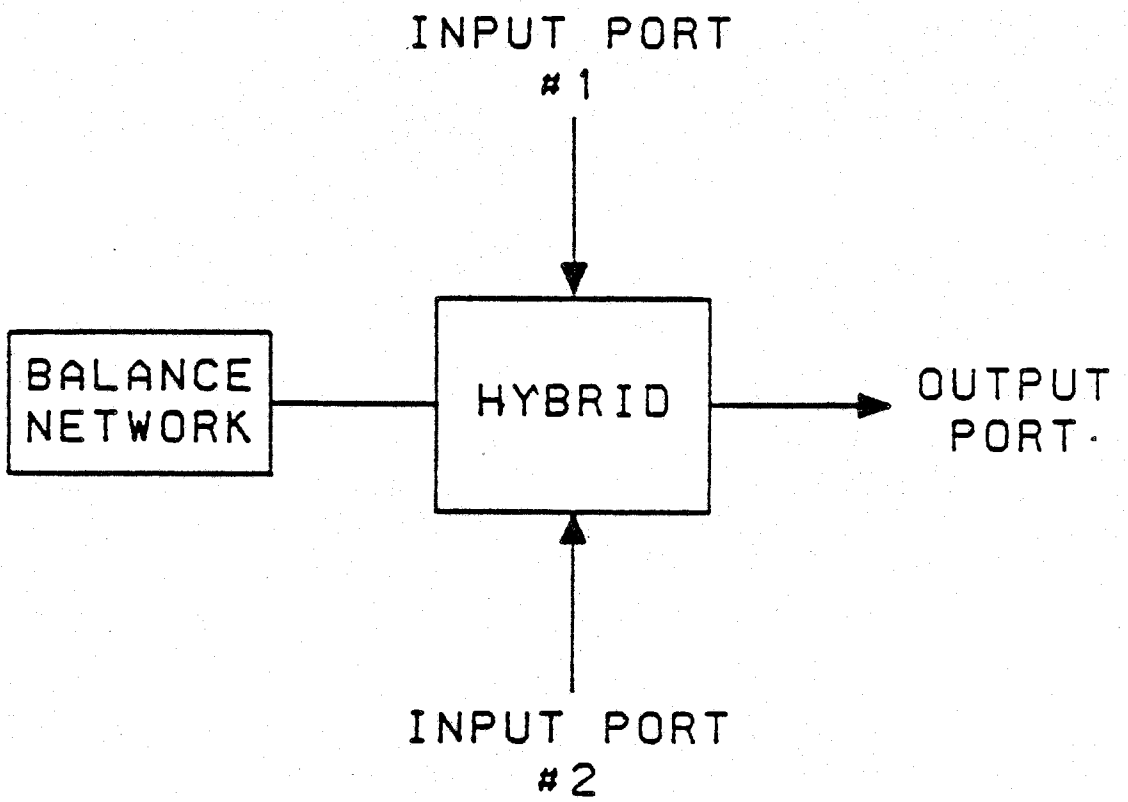

INPUT PORT
#1
BALANCE
NETWORK
HYBRID
OUTPUT
PORT
INPUT PORT
#2

FIG.1-HYBRID

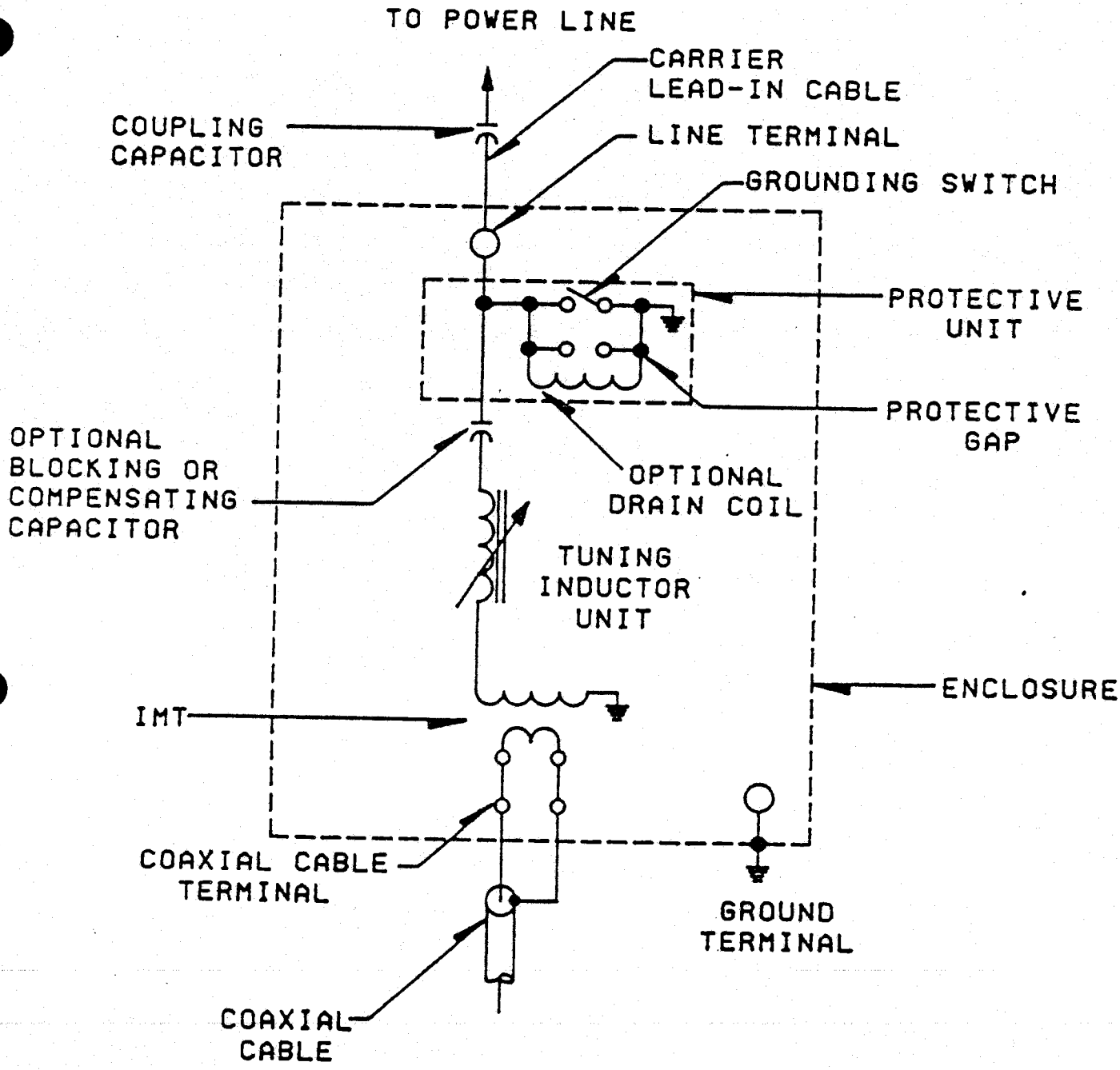


FIG.A-1 SINGLE-FREQUENCY LINE TUNER FOR PHASE-TO-GROUND COUPLING.

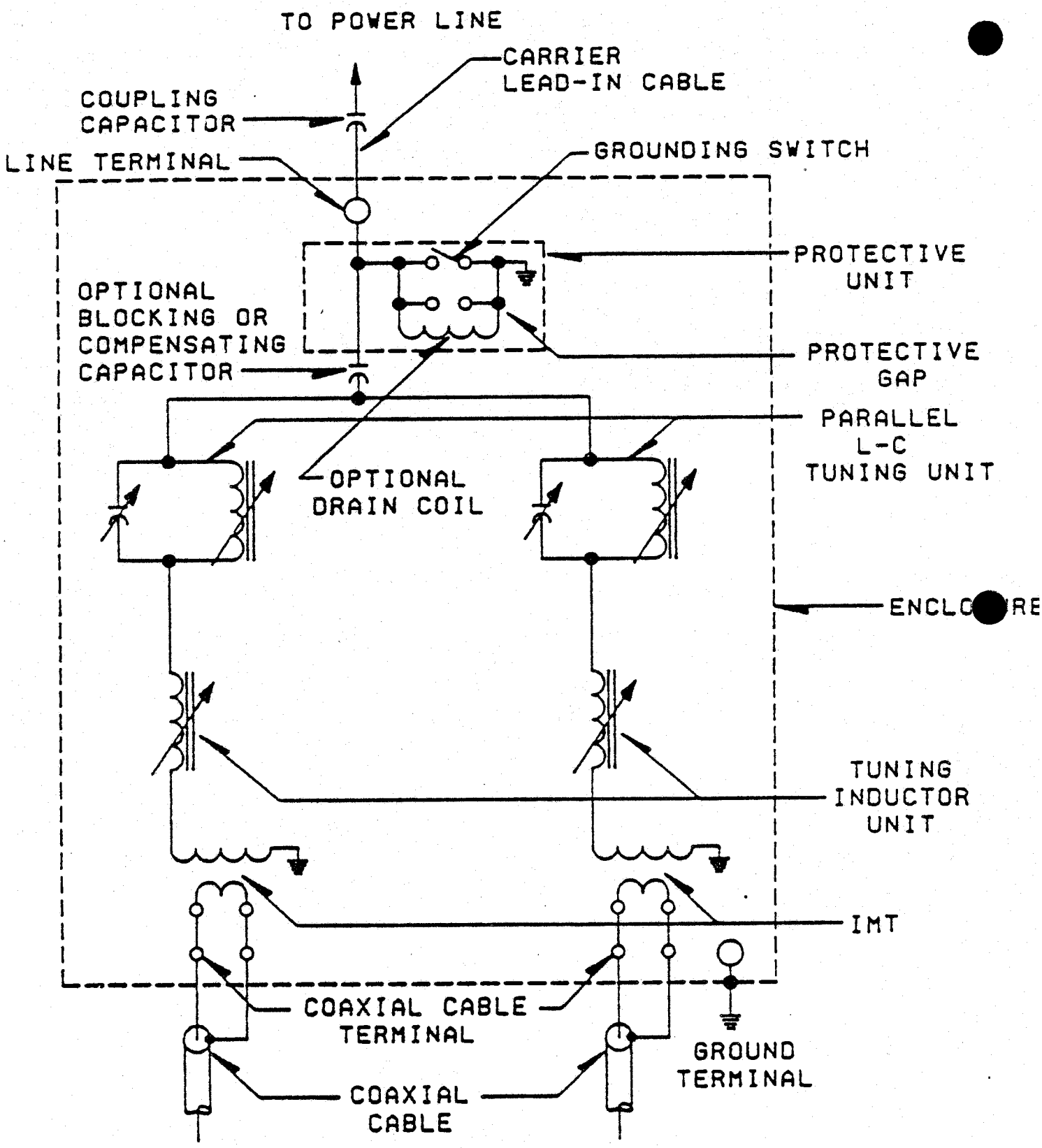


FIG.A-2 TWO-FREQUENCY LINE TUNER FOR PHASE-TO-GROUND COUPLING.

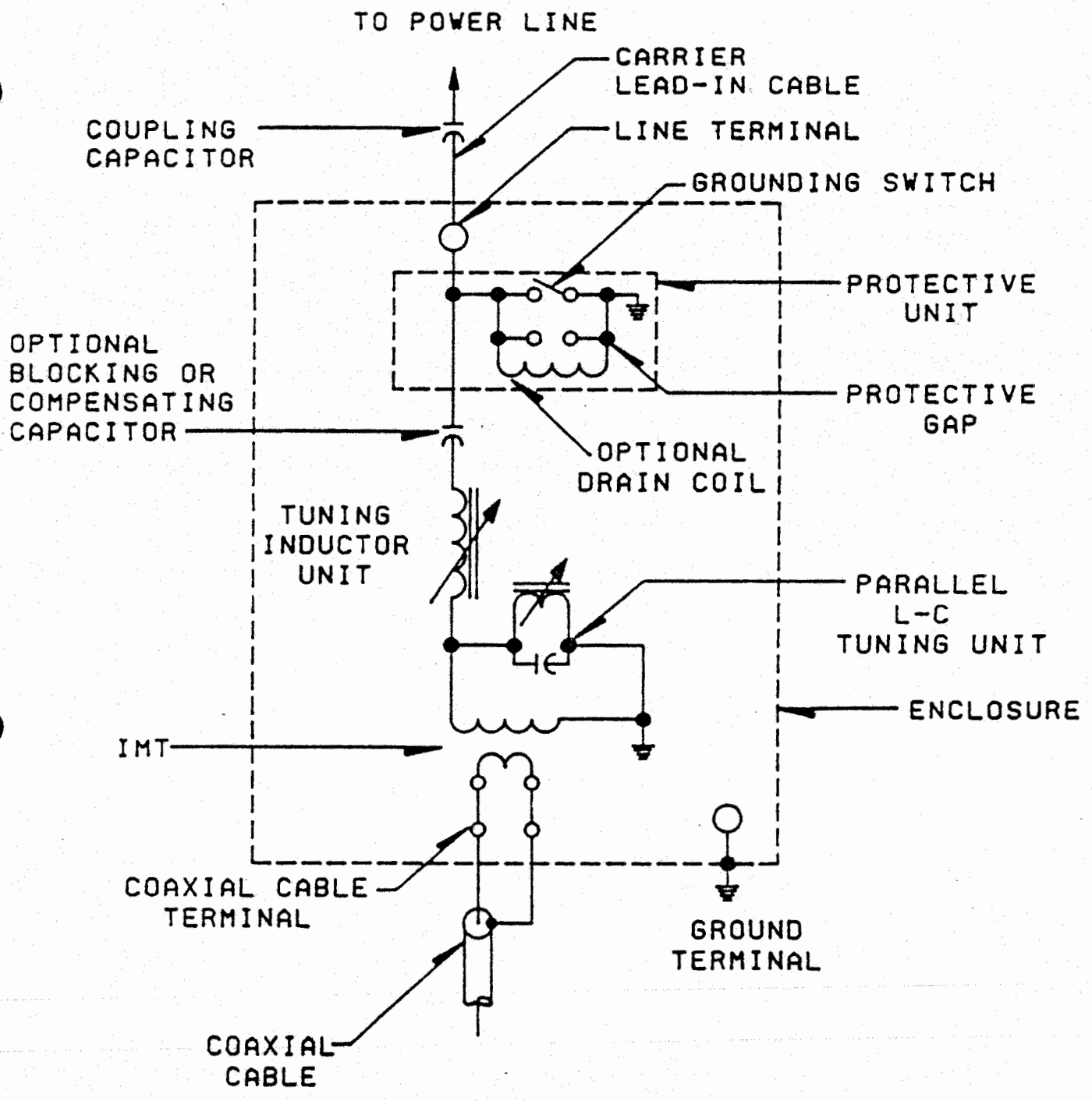


FIG.A-3(a) WIDEBAND LINE TUNERS FOR PHASE-TO-GROUND COUPLING (BAND-PASS)

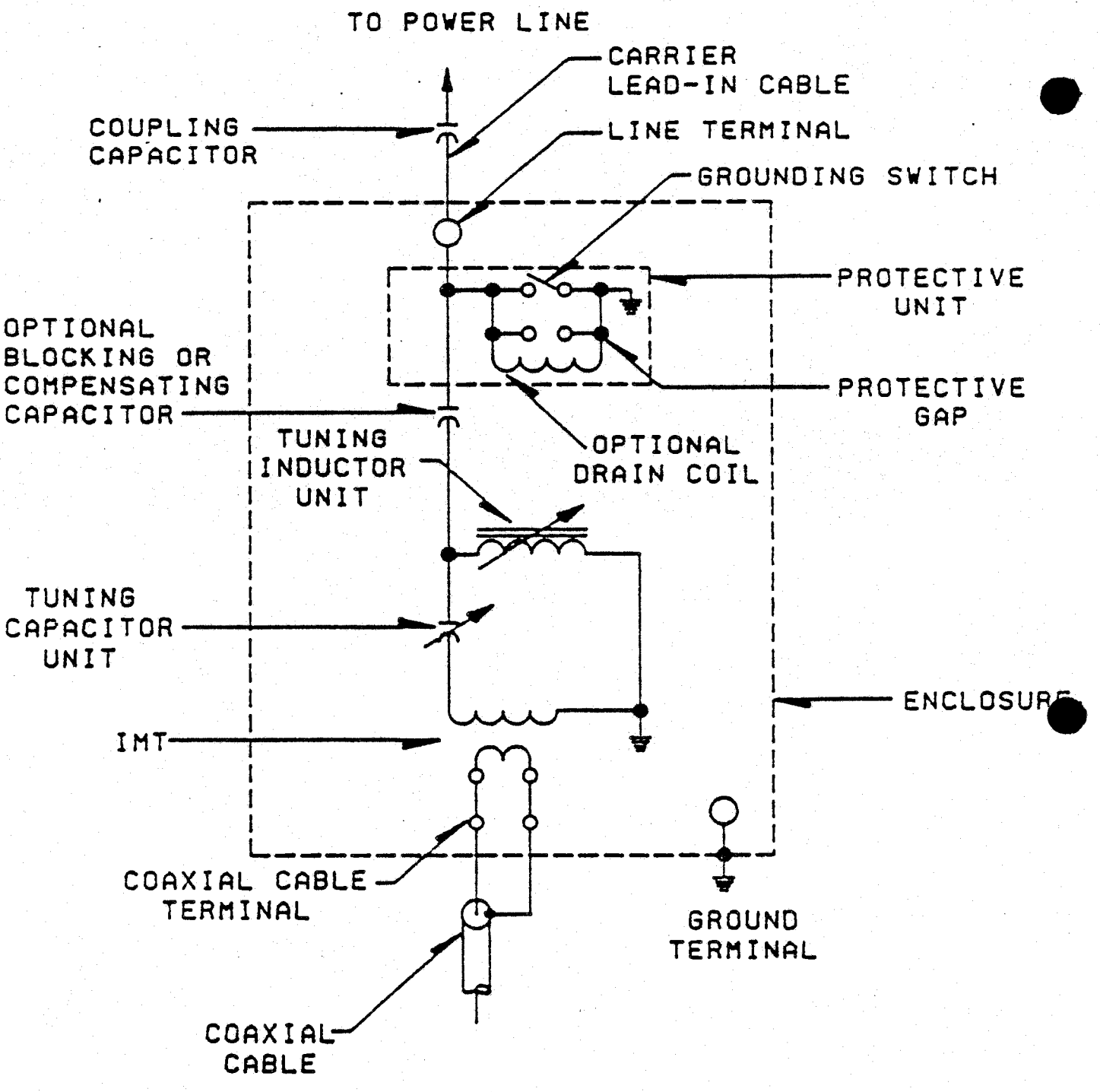


FIG.A-3(b) WIDEBAND LINE TUNERS FOR PHASE-TO-GROUND COUPLING (HIGH-PASS)