M. F. Baber - St. Louis

October 2, 1970

J. G. Bryant
R. Davis
D. A. Olson/
T. L. Gossage

UNDERGROUND POWER TRANSMISSION CONFERENCE

P. G. Benignus
R. H. Munch
W. R. Richard

Please find attached a list of handouts given out at the "Underground Power Transmission Conference" which I recently attended. The first three handouts are attached to the addressees' copy of this memo.

The present status in underground power transmission is adequately described in handouts (2) and (3). Three possible business opportunities for our group are discussed below. However, because of the small volume of fluids consumed in power cables, and because some of these needs will not develop into significant markets for another 5 to 10 years, the business opportunities for Monsanto related to underground power transmission are limited.

The tabulation below lists cable voltages which will be installed before 1980, the number of miles which will be energized during the three years from 1973 to 1975, and the type of underground cable system which will be used for each voltage level.

Line Voltage	Miles Energized 1973-75		Type of Underground Cable System
	Overhead	Underground	
115 KV-230 KV	18,600	690	Mostly oil-filled pipe cable-Some extruded P.E.
345 KV	6,400	380	Pipe cable
500 KV	3,500	--	Force-cooled pipe cable
765 KV	650	--	Force-cooled pipe cable - Probably Synthetic paper insulation and Synthetic oil.
1100 KV	--	--	Probably pressurized SF_6, maybe force-cooled pipe cable with synthetics.
Above 1100 KV	--	--	Pressurized gas and cryogenic systems.

DSW 201845

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Synthetic Fluids and Papers

As indicated in the ~~attached~~ sheet table, most underground transmission which will be installed before 1980 will be at 500 KV and below. For such systems, cellulose paper insulation impregnated with mineral oil or polybutene is satisfactory. Synthetic polypropylene paper impregnated with a compatible (synthetic?) fluid will probably be used for 765 KV underground systems, but few of these will be installed before 1980.

Synthetic papers, films and impregnants for underground cables must be compatible with one another. There is presently no problem with compatibility, but there may be at 750 KV. For instance, mineral oil swells polyethylene film and paper too much.

The Electric Research Council (ERC) has given 3M Company a contract to develop and test polypropylene synthetic paper. This will probably be the solid dielectric material used in 765 KV cables and some 500 KV cables. DuPont is also a likely producer of such a paper. This could be a business opportunity for Monsanto. As an aside, present thinking is that the solid insulation in cryogenic cables will be polyethylene paper or spun bonded polyethylene. If this market develops, it will not be significant until about 1980.

Fluids are needed which are compatible with polypropylene at as high a temperature as possible, certainly to 100°C; 130°C would be better.

At 750 KV and/or at temperatures above 100°C the dissipation factor and consequent heat generation of mineral oil goes up rapidly. The synthetic fluid should not have these limitations.

A significantly higher price than mineral oil could be obtained for a synthetic fluid which is compatible with paper and which retains an inherently low power factor at temperatures of 120°C or above. Such a product might replace mineral oil for many lower voltage applications.

Of course, a fluid which in combination with paper has a significantly lower dielectric constant than mineral oil/paper would be desirable. A significant premium over mineral oil should be paid for its use at 500 KV and above. Below 350 KV, little premium probably would be paid.

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Dodecyl Benzene

This impregnant has a slightly bad name in the U.S. cable industry because it performed poorly in a series of ERC tests. However, many persons may not realize that the paper used in those tests contained contaminants which distorted test results. Thus, if this product is better than mineral oil or polybutene it may have a small market in high voltage cables.

Dodecyl benzene was used in cables produced by Pirelli of Italy to connect a chain of islands off the New England Coast. It was used more for its hydraulic properties than its improved electrical properties.

Films

Plastic films were investigated as potential cable wrap for 750 KV cables. They were discarded because they could not be completely saturated with fluid. As in transformers, the development of a film which can be completely saturated with fluid should yield a marketable product.

An alternative solution would be to develop a method to form a high dielectric strength gel in the paper cable wrap.

MICHAEL F. BABER

ms

Atts.

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UNDERGROUND POWER TRANSMISSION CONFERENCE
HANDOUTS

Attached

1. Program and Speakers
2. Underground Transmission in the United States,
   A. F. Corry, Boston Edison Co., 1969
3. Developments in Underground Transmission
   R. C. Waldron, The Okonite Co., April 1970

Not Attached

4. Addresses of Registered Conferees and Leaders
5. Present Underground Transmission Techniques,
   F. J. Bender
6. Gas Insulated Systems, ITE Imperial Corp.
7. Operating Parameters of Compressed-Gas-Insulated
   Transmission Lines, H. C. Doepken, et al., 1969
8. A New Concept for Power Cost Underground Transmission
   and Termination, P.F. Pugh
9. Underground Power Transmission, A Report to the
   Federal Power Commission, 1966
   (The Bible of Underground Power Transmission,
   approx. 200 pages)

DSW 201848

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MAIL TO:

Engineering Registration
The WISCONSIN CENTER, 702 Langdon Street
Madison, Wisconsin 53706

UNDERGROUND POWER TRANSMISSION, September 24-25, 1970

Name _____
(please print)

Title/Position _____

Company _____

Address _____

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Fee: $70.00

Make checks payable to *University Extension.*

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CLIP AND MAIL

GENERAL INFORMATION

Enrollment: Payment of program fee should accompany each enrollment. Covers cost of sessions, handout or course materials, noon lunches, one evening dinner and break refreshments. Lodging is **NOT** included.

Meeting Place: Check program schedule. Unless noted otherwise, Madison programs are held at THE WISCONSIN CENTER, Madison campus, corner of Langdon and Lake streets.

Lodging: Various hotels and motor hotels in the vicinity offer accommodations. Information and maps with campus details will be sent to registrants. Reservations are urged in advance. Arrange directly with the place of your choice.

Parking: Visitor parking on campus is extremely limited. University marked AREAS are restricted. There is nominal-fee parking at the Murray Street lot and at the corner of State and Lake; also metered parking at the municipal Lake Street Ramp between State and University Avenue. (All just one block from The Wisconsin Center) Adjacent hotels/motels provide free parking with rooms.

Refund: Full refund of fee payment will be made if program is cancelled or if notice of cancellation by enrollee is received at least a day in advance of Institute programs and a week in advance of Short Course programs.

A CERTIFICATE of Participation is awarded to each enrollee.
–NO PROCEEDINGS WILL BE PUBLISHED–

David P. Hartmann — Program Director
University Extension, The University of Wisconsin
Department of Engineering, 432 North Lake Street
Madison, Wisconsin

TEL./(608) 262-2061 for Program Information
/(608) 262-1122 for Program Enrollment

UNDERGROUND POWER TRANSMISSION
September 24-25, 1970

In cooperation with
Departments of Electrical and Nuclear Engineering, College of Engineering, The University of Wisconsin

THURSDAY, SEPTEMBER 24, 1970

A.M. (CDT)

8:30 Registration
The Wisconsin Center
702 Langdon Street
Madison, Wisconsin

8:50 Introduction
Professor Harold A. Peterson
Wisconsin Utilities Association
Electrical Engineering Department
The University of Wisconsin
Madison, Wisconsin

9:20 Underground Power Transmission in the United States
Andrew F. Corry
Boston Edison Company and
Chairman, Electrical Research Council Steering Committee on Underground Transmission

10:35 Break

11:00 525KV Cables for the Grand Coulee Third Power Plant
James J. Ray
Electrical Engineer
U.S. Bureau of Reclamation
Power and Pumping Plant, Design Section
Denver, Colorado

P.M.

12:15 Lunch

1:30 Various Techniques for Cable Transmission
Frederick J. Bender
Vice President, Sales & Engineers
Jerome UTE, Inc.
Farmingdale, New York

2:15 Break

2:45 A New Concept for Lower-Cost Underground Transmission and Termination
Paul F. Pugh
Engineer
Beamer/Wilkinson & Associates
Oakland, California

4:00 Adjourn

5:30 Social Hour

6:30 Dinner
Doubl-H Steak Ranch
702 Midvale Blvd.
Madison, Wisconsin
"The Cryogenic Probe"
Dr. Charles L. Teeter
Bio-Engineer
Wisconsin Alumni Research Foundation
Madison, Wisconsin

FRIDAY, SEPTEMBER 25

A.M.

9:00 Cryogenic Cable for Underground Power Transmission
Dr. Michael J. Jeffries
Electrical Engineer
Thermal Branch, Mechanical Engineering Laboratory
Research and Development Center
The General Electric Company
Schenectady, New York

10:15 Break

10:45 Pressurized Gas Insulation for Underground Transmission
Dr. Herbert C. Doepken, Jr.
Project Manager, EHV Cables
High Voltage Power Corporation
Burlington, Massachusetts

12:00 Lunch

P.M.

1:00 The Underground Gas Insulated Bus
E. Robert Perry
Chief Engineer
Greensburg Division
I-T-E Imperial Corporation
Greensburg, Pennsylvania

2:15 Panel Discussion
Professor Harold A. Peterson (Discussion Leader)

3:15 Presentation of Certificates

3:30 Final Adjournment

DSW 201849

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INSTITUTE OBJECTIVES

This institute has been designed to provide utility and supplier engineers with an in-depth review of research and development projects and installation experiences in underground power transmission. Emphasis is placed upon the growing need for this method for solutions to right-of-way problems and enhancement of system reliability through the use of this power-transmission technique.

Underground cable produces unique problems in termination, insulation and cooling requirements. The Institute program includes discussions of a variety of research and installation projects using cryogenics, pumped oil, pressurized gas and other techniques for cooling and insulation.

The nationally recognized experts presenting these topics make this an important meeting for all engineers and researchers interested in the current state of the art of this rapidly growing aspect of electric power transmission.

AN ENGINEERING INSTITUTE

UNDERGROUND POWER TRANSMISSION

September 24-25, 1970

department of engineering/UNIVERSITY EXTENSION/the university of wisconsin

UNIVERSITY EXTENSION
The University of Wisconsin

Department of Engineering
432 North Lake Street
Madison, Wisconsin 53706

UNDERGROUND POWER TRANSMISSION
September 24-25, 1970

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