

Electro -
Magnetic
Transients
Program
(E M T P)
Theory Book

Branch of System Engineering
Bonneville Power Administration
Portland, Oregon 97208-3621
United States of America

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Paper copies of the original, public-domain work were distributed by BPA under cover of an official letter dated 10 June 1987 that was signed by Drs. Tsu-huei Liu and W. Scott Meyer.

PREFACE

To operate an electric power system reliably, and to plan its expansion properly, utility engineers perform a variety of network studies. The most common types of network studies are

- short circuit (or fault) analysis,
- power (or load) flow analysis,
- stability analysis, and
- analysis of electromagnetic transients.

Among these, studies concerned with electromagnetic transients are probably the most complicated ones. For the beginner, there is the difficulty of developing an understanding of the nature of electromagnetic transients in power systems, in addition to the difficulty of learning how to simulate them with the Electromagnetic Transients Program (EMTP). The problem is much easier for the expert, who needs only minimal advice on how to use the EMTP properly. Both the beginner and the expert must have some understanding of the limitations and inherent errors of EMTP simulations, however.

Thus began the writing of the original prime contractor who was paid by BPA to assemble this work, Prof. Hermann W. Dommel of the University of British Columbia in Vancouver (Canada). More modern history can be found in Can/Am EMTP News, the newsletter of the North American user group. Pasting from the July, 1994, and July, 1995, issues is the following story about the conversion to computer storage:

July, 1994 : BPA EMTP Theory Book in WP 5.1

The 700-page EMTP Theory Book of BPA is being converted to WordPerfect 5.1 storage from the crummy, old, paper copy that was submitted by Prof. Hermann W. Dommel of the University of British Columbia (located in Vancouver, B.C., Canada) in 1987. More information

should be provided in the next (October) newsletter. Work has been started by Kwang-yi Ger, Dr. Tsu-huei Liu's daughter, who recently finished her second year as a student of journalism at the University of Washington in Seattle (USA). Ms. Ger is a good writer, and she knows WordPerfect. Initially, the content of all figures will be ignored. If any reader has ideas about how best to handle graphics of BPA's Theory Book, he is encouraged to share his understanding with the Can/Am user group. Current thinking is that, initially, all figures might be scanned to produce bitmaps. To avoid making this added burden mandatory, the files should be kept external. Later, one at a time, some of these then might be replaced by vector storage.

For those readers who may have forgotten, or may never have known, Prof. Dommel signed a contract with BPA around the end of August, 1981. Among other things (cable research by Luis Marti), this contract provided payment of about \$100K to Prof. Dommel for delivery of the book within 4 years. Well, the 4 years passed, but the Theory Book (named *Reference Manual* only for purposes of the contract) was not ready. This was around the end of August, 1985. So, without penalty, BPA allowed Prof. Dommel another entire year. This time, the manuscript was submitted. However, it was not yet usable because it included many pieces of intellectual property that belonged to others, and for which the professor had not obtained permission to use. This explains paragraph 3 of the official BPA form letter by Drs. Liu and Meyer dated June 10, 1987: *"Since the early fall of 1986 when BPA received the manuscript from the contractor, there has been an effort to obtain permission for BPA to publish all portions of the book that were copyrighted by others. This has been completed to the satisfaction of the BPA contracting officer, who just recently gave his approval for BPA to print this work, and to distribute copies to others."*

Back to the first paragraph. The perceptive reader might already have asked himself: convert from *paper* to WordPerfect? Did Prof. Dommel never supply BPA with a computer-stored (e.g., magnetically-stored) copy of the text? That is correct: only a paper copy was supplied by Prof. Dommel, who claimed that his disk files somehow had been lost. So, the keying by Kwang-yi Ger continues in West Linn.

July, 1995 : BPA EMTP Theory Book in WP 5.1

The 700-page EMTP Theory Book of BPA has been converted to WordPerfect 5.1 storage from the crummy, old, paper copy that was submitted to BPA in 1987 by its contractor, Hermann Dommel. The present mention is a continuation of the story in the January issue.

Kwang-yi Ger, the daughter of Drs. Tsu-huei Liu and Kai-hwa Ger, did all the non-table text (including all equations) with some help from her mother, recall. Now, Kwang-chien Ger, the younger son, has completed the operation by adding all figures as .TIF bitmaps. Both high- (300 dpi) and low- (75 dpi) resolution copies were produced, and then included by WP5.1 to convert to equivalent, compressed .WPG files. The .WPG files are stored externally, and there are two sets. Compressed sizes of these are 2763 and 531 Kbytes, respectively. After unzipping, these become 7091 and 1091 Kbytes.

Improved resolution of some figures is a result that may surprise the average reader. Normally, creating a bitmap from an original results in distortion that includes loss of resolution. But what if the original already involves substantial distortion, typically due to substantial photoreduction? Using a photocopy machine, there is no way to recover the lost resolution. But with computer scanning, human intelligence can be applied in the form of graphical editing of the bitmap. The H-P software that allows this is *HP Paintbrush*, which Kwang-chien has been using effectively on some figures such as 6.33 and 12.1. If some figures look significantly better than the original printed copy that was submitted by contractor Dommel, it is because they have been improved!

Co-Chairmen of Canadian/American EMTP User Group

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