

109.9/PO/83/10/27/0

- 1 -

NOV 16 1983

DISTRIBUTION

WM s/f (3109.9)	MKNAPP
WMGT r/f	PORNSTEIN &
NMSS r/f	r/f
CF	PJUSTUS
MBELL	PDR
JTGREEVES	
HJMILLER	
LHIGGINBOTHAM	
JBUNTING	

MEMORANDUM FOR: Robert E. Browning, Director  
Division of Waste Management

FROM: Malcolm Knapp, Acting Branch Chief  
Geotechnical Branch  
Division of Waste Management

SUBJECT: TOUGH CODE IMPLEMENTATION AT BNL

As per the attached memo, please be informed that Operating Plan Commitment 31311 "Transfer of the TOUGH (MULKOM) code to the NRC" (due 11/15/83) has been completed. Formal documentation of the TOUGH code is being prepared by Sandia under FIN A-1158.

The TOUGH code is intended to model groundwater flow in the unsaturated zone at NNWSI. I intend that future model development concerning unsaturated zone hydrology will include a radionuclide transport code to couple with the flow-field output from TOUGH. Also, as theoretical work arising from the University of Arizona's flow through unsaturated rock contract becomes available, I anticipate that the TOUGH code (or some other suitable code) will be modified to reflect that work, thereby enhancing WMGT's modeling capabilities for NNWSI.

If you would like additional information concerning the TOUGH code or related matters, Peter Ornstein of my staff will be happy to brief you.

**"ORIGINAL SIGNED BY"**

Malcolm Knapp, Section Leader  
Hydrology Section  
Geotechnical Branch  
Division of Waste Management

Attachment:  
As stated

WM Record File 109.9

WM Project 1

Docket No. \_\_\_\_\_

PDR

LPDR \_\_\_\_\_

Distribution: \_\_\_\_\_

\_\_\_\_\_

(Return to WM, 623-SS) C2

OFC :	WMGT	:	WMGT	:		:		:
NAME :	<u>PO</u> PORNSTEIN:dm	:	MRKNAPP	:		:		:
DATE :	11/17/83	:	11/19/83	:		:		:

8312080140 831116  
PDR WASTE PDR  
WM-1



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

NOV 1 1983

MEMORANDUM FOR: Malcolm Knapp, Section Leader  
Hydrology Section  
Geotechnical Branch  
Division of Waste Management

FROM: Peter Ornstein  
Geotechnical Branch  
Division of Waste Management

SUBJECT: TOUGH CODE IMPLEMENTATION AT BNL

The TOUGH code was received from LBL and successfully implemented at the BNL computing facility thereby satisfying Operating Plan Commitment 31311. Successful implementation included code compilation and execution of four sample problems.

The TOUGH code is a multi-dimensional integrated finite difference computer code capable of simulating non-isothermal fluid and gas flow in a variably-saturated media. It's gridding geometry may be highly irregular and can be used to simulate flow through discrete fractures. However, the number of grid blocks are limited to approximately 500 due to Large Core Memory limitations of the BNL computer. The code also has extensive internal documentation (i.e., important variables and algorithms are defined, and there is also a running commentary).

The TOUGH code has widespread applicability to canister scale, repository scale, and larger scale hydrogeologic assessment. Some of these applications include:

- Simulation of repository resaturation.
- Simulation of advective and/or thermally induced fluid flow.
- Simulation of advective and/or thermally induced gas flow.
- Simulation of the thermal environment.

JCL instructions for accessing TOUGH and the sample problems are attached. Any staff interested in learning how to use TOUGH should contact me for additional instructions and documentation.

A handwritten signature in cursive script that reads "Peter Ornstein".

Peter Ornstein  
Geotechnical Branch  
Division of Waste Management

8311210118

The TOUGH code, along with a sample problem input file, may be accessed from BNL's MFZ in the following manner:

<u>JCL Language</u>	<u>Comments</u>
ORNST,STMFZ,TPO,T177.	Job Control Card
ACCOUNT,ORNSTEIN,1349,1349.	Account Card
ATTACH,BT,ORNSTEINTOUGHBINARY,ID=ZZRNRC,CY=001,MR=1.	Access TOUGH
FILE,DATA,RT=Z,BT=C,FL=90.	See Below
ATTACH,DATA,fname,ID=TOUGH,ST=MFA,MR=1.	Access Input File
BT,DATA.	Execute TOUGH
EXIT,U.	
REWIND,DATA.	
COPYSP,DATA,OUTPUT.	Print Input File
*EOR	
*EOF	

Where fname = RURF	Canister Sample Problem
= GATUF	Geothermal Sample Problem
= RBM41	1-D Infiltration Problem
= RBM42	2-D Infiltration Problem

FILE Card is necessary to access Sample Problems from MFZ.