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

JUN 15 1979

To Those On The Attached List

Gentlemen:

Subject: Condensation Workshop Held in Silver Spring on May 24-25, 1979

The workshop recommendations for condensation models in TRAC are shown in Table I. The recommendations are presented in terms of  $Q_i = Q_{Li} = h_i A_i (T_L - T_{SAT})$  and are intended for use in a calculation logic diagram such as that shown in Figure 1.

$Q_{Gi} = 0$  unless the steam is superheated. For this case, a recommendation was made for heat transfer from superheated steam to water drops:

$$Q_{Gi} = h_i A_i (T_G - T_{SAT})$$

with  $h_i$  determined from the Ranz-Marshall relation

$$Nu_G = 2 + 0.5 Re^{1/2} Pr^{1/3}$$

Enclosed are lists of papers handed out

- a) at the beginning of the meeting, and
- b) during the meeting.

Copies of these papers can be obtained from NRC by request.

Sincerely,

*Low*

L. M. Shotkin  
Analysis Development Branch  
Division of Reactor Safety Research

Enclosures: as stated

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JUN 5 1979

Addressees of Letter Dated \_\_\_\_\_

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W. S. Farmer, NRC/RES  
N. Zuber, NRC/RES  
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Y. Y. Hsu, NRC/RES  
W. Beckner, NRC/RES  
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R. Pryor, LASL  
P. Bleiweis, LASL  
W. Rivard, LASL  
J. Mahaffey, LASL  
J. Block, CREARE  
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R. Duffey, EPRI  
S. Levy, SLI  
G. Bankoff, NWU  
T. Theofanous, Purdue  
R. Tiller, DOE-ID  
P. North, INEL  
H. Sullivan, INEL  
M. Thurgood, PNL  
P. Saha, BNL  
R. Collier, BCL  
J. Andersen, GE  
L. Hochreiter, W  
FRG Representative c/o E. Dluzniewski  
E. Hicken  
H. Kirmse  
H. Watzinger  
H. Viecez  
JAERI Representative c/o K. Hirano  
Y. Murao  
PDR (2)

TABLE I

5/79 WORKSHOP RECOMMENDATIONS FOR CONDENSATION MODELS IN TRAC,

$$Q_i = h_i A_i (T_L - T_{SAT}); i = \text{liquid/vapor interface}$$

MODEL	$h_i$		$A_i$
	Steam/Water	Correction for Noncondensable Gas	
I CONDENSATION OF STEAM ON SUBCOOLED WATER JETS	$St = 2 \times 10^{-2} \sqrt{\frac{d}{l}} = \frac{h_i}{V \rho C}$ Note 1	$h = h_i 0,366 \left[ \frac{G_a G_L}{G_v^2} \right]^{-0.2}$ $h \leq h_i$ Note 2	$\pi d l$
II CONDENSATION OF STEAM ON SUBCOOLED WATER DROPS	$Nu = \frac{2\pi^2}{3} * C$ $C = 2.7$ Note 3	Same as for jets	$4 \pi R_{MEAN}^2 N$ $R_{MEAN} \rightarrow We \approx 4$
III CONDENSATION IN DOWNCOMER DURING COLD-LEG INJECTION	Same as for jets	Same as for jets	1. "Bridged" flow area 2. film flow on walls
IV CONDENSATION OF STEAM IN POOL ABOVE TIE-PLATE	$> 350 \text{ KW/M}^2 / \text{K}$ Note 4	No correction required	Total Pool Flow Area Note 4

Note 1: T. Theofanous, Paper presented at this meeting

Note 2: G. Shklover and M. Rodivlin, Teploenergetika, No. 4, P. 48, 1976

Note 3: Asymptotic conduction solution. Factor C is for circulation-augmented conduction, R. Kronig and J. Brink, Applied Science Res., A2, 142 (1950).  $Nu=2Rh/k$ 

Note 4: G. Bankoff and H. Yuen, to be published.

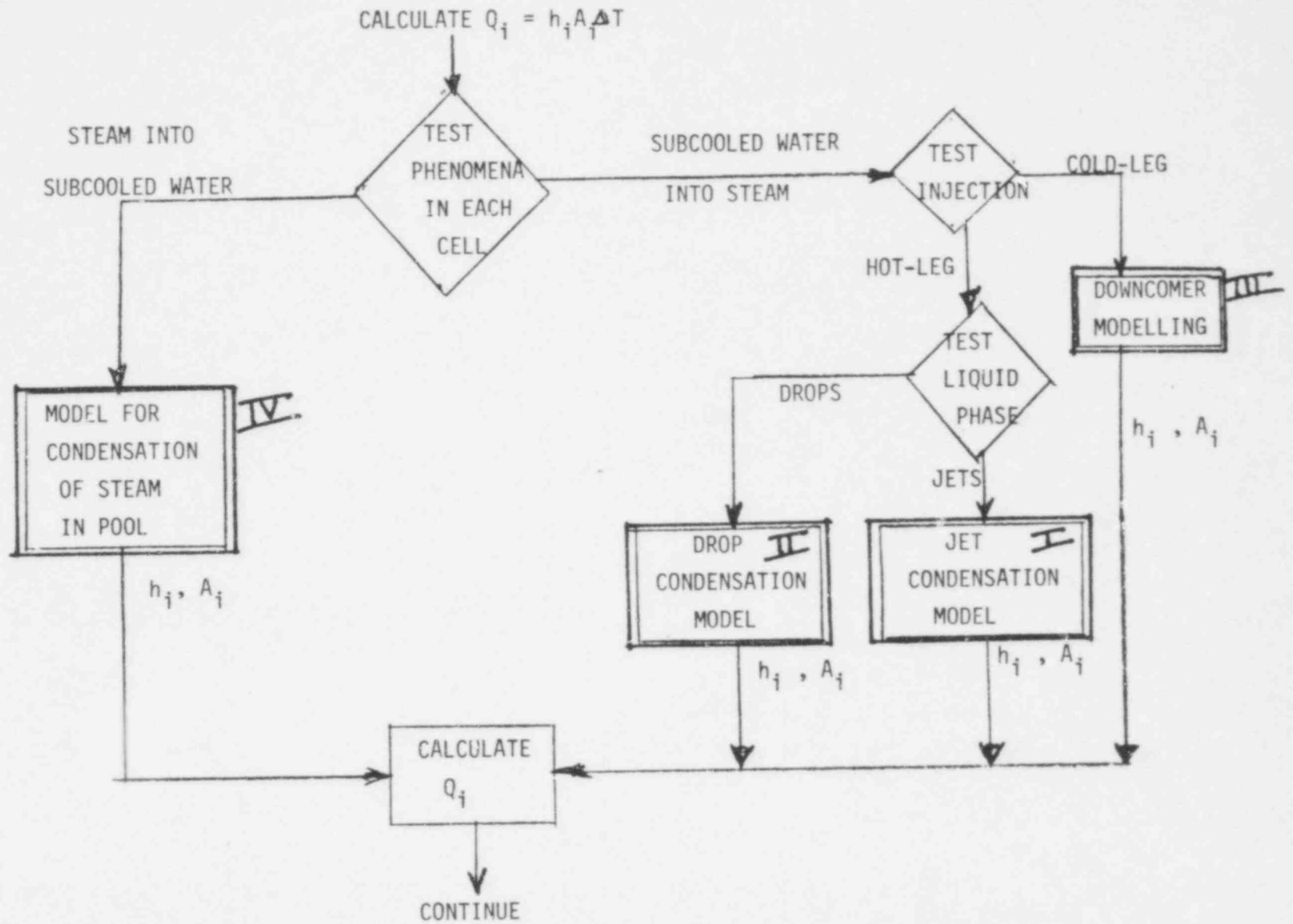


FIGURE 1

Papers and Copies of Slides handed out during the meeting

Background and Goals	L. S. Tong, NRC
Agenda and Workshop Procedure	L. M. Shotkin, NRC
ECCS with Combined Cold and Hot Leg Injection	Hicken, Kirmse, Watzinger, FRG
A Review of Condensation of Steam on Subcooled Water Jets	P. Saha, BNL
Applicable Models and Data in Russian Literature	N. Zuber, NRC
Interfacial Mass and Momentum Transfer in Two-Phase Flow	Bankoff, NWU
Slide Presentation of Bankoff	
Slide Presentation of BCL	Collier, BCL
Modeling of Basic Condensation Processes	T. Theofanous, Purdue
Slide Presentation of Theofanous	
Review of Water Spray into Steam	S. Levy, SLI
Slide Presentation of Levy	
BWR Experience on Spray Phenomena	J. Andersen, GE
Direct Contact Condensation in Reactor Safety Research	J. A. Block, CREARE
Slide Presentation by Daly, LASL	
Slide Presentation by Yuen, NWU	
Slide Presentation by J. Andersen, GE	
Slide Presentation by Vienez, Tech U. of Hanover, FRG	
Reporter Recommendations	

Papers Handed Out at the Beginning of the Meeting

Excerpts on Condensation Modeling from the TRAC-P1A Manual

On the Unsteady Phenomena Relating to Vapor Suppression, T. Saito et al,  
ASME Paper 74-WA/HT-47, 1974

Study of Condensation of Single Vapor Bubbles in a Layer of Subcooled Liquid,  
A. Voloshko and A. Vurgaft, Heat Transfer, Soviet Research, 3, 160, March, 1971.

Vapor-Liquid Interaction in a High Velocity Vapor Jet Condensing in a Coaxial  
Water Flow, R. Young et al, Notre Dame.

Condensation of Vapor on Free Cold-Liquid Jets, K. Dementyeva and A. Mikarov,  
Heat Transfer, Soviet Research, 9, 116, January, 1974.

Condensation-Driven Fluid Motions, J. Block, CREARE, EPRI Workshop, Tampa, Fla.,  
March, 1979.

Condensation of Steam on Water in Turbulent Motion, R. M. Thomas, To appear in  
Int. Jr. Ht. & Mass Transfer, 1979.

Some Condensation Studies Pertinent to LWR Safety, S. Bankoff, EPRI Workshop,  
Tampa, Fla., March, 1979.

A Study of the Condensation of Vapour Jets Injected into Subcooled Liquid Pools,  
C. Greef, CEGB, England, RD/B/N 3267, March, 1975.

Microscopic Study of Dropwise Condensation, J. Welch and J. Westwater,  
International Developments in Heat Transfer, 1961-62, ASME.