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AUTH.NAME AUTHOR AFFILIATION
ALEXICH,M.P. Indiana & Michigan Electric Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards 850402 ltrs re description of LOCA/ECCS models used by Exxon Nuclear Co in response to 850329 request. Error described in Exxon 850322 Ltr GFO:845:010 applicable to Unit 1 only.

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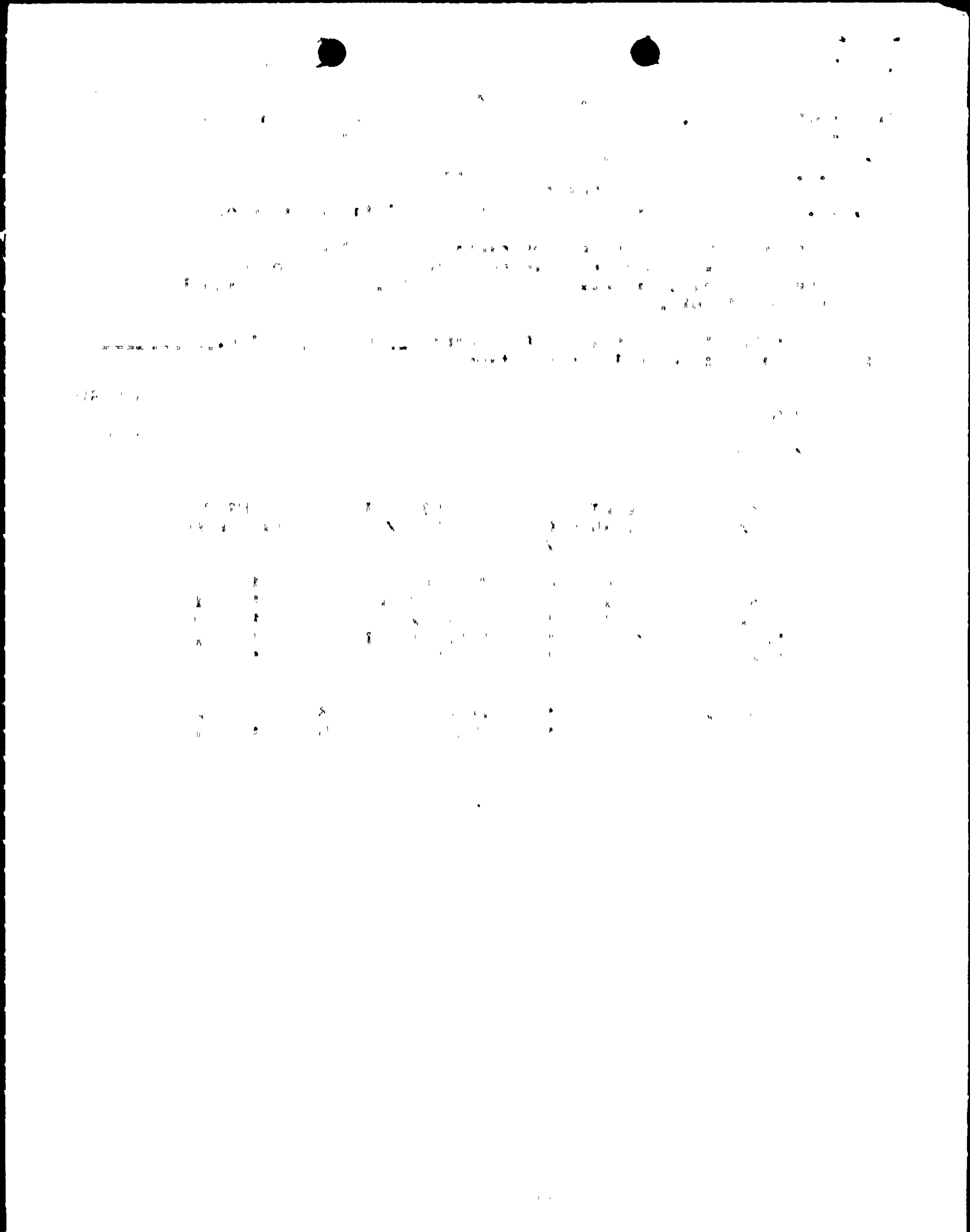

INDIANA & MICHIGAN ELECTRIC COMPANY

P.O. BOX 16631
COLUMBUS, OHIO 43216

AEP:NRC:0745V
April 3, 1985

Donald C. Cook Nuclear Plant Units No. 1 and 2
Docket No. 50-315, 50-316
License No. DPR-58, DPR-74
DESCRIPTION OF LOCA/ECCS MODELS USED BY EXXON NUCLEAR COMPANY

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

This letter is submitted pursuant to discussions with your staff concerning the LOCA/ECCS models used by Exxon Nuclear Company for analysis of the Donald C. Cook Nuclear Plant, Units 1 and 2. Attached please find letters HGS:100:85 and ENC-AEP/0437, both dated April 2, 1985, which describe the LOCA/ECCS models used for D. C. Cook Units 1 and 2, respectively. We are immediately forwarding this information as requested by members of your staff during a meeting on March 29, 1985.

It is of note that we were advised by Exxon Nuclear Company that the coding error described in their letter GFO:85:010, dated March 22, 1985, is applicable to Unit 1 only. The Unit 2 information is being transmitted for completeness and future reference purposes.

This document has been prepared following Corporate procedures which incorporate a reasonable set of controls to insure its accuracy and completeness prior to signature by the undersigned.

Very truly yours,

M. P. Alexich
Vice President RBK 4/3/85

JLB:wj
Attachments

A001
1/1

Attachments:
A. HGS:100:85, dated April 2, 1985, from H. G. Shaw to J. L. Bell
B. ENC-AEP/0437, dated April 2, 1985, from H. G. Shaw to G. John

cc: John E. Dolan
W. G. Smith, Jr. - Bridgman
George Bruchmann
R. C. Callen
R. Charnoff
NRC Resident Inspector - Bridgman
G. F. Owsley, ENC - Richland, WA

EXXON NUCLEAR COMPANY, INC.

600 108TH AVENUE NE. PO BOX 90777 BELLEVUE, WA 98009
(206) 453-4300

April 2, 1985
HGS:100:85

Mr. J. L. Bell
Nuclear Materials & Fuel Mgmt.
Indiana & Michigan Electric Co.
c/o American Electric Power Service Corp.
One Riverside Plaza
Columbus, OH 43216-6631

Dear Joe:

This information is provided to you in accordance with Exxon Nuclear's agreement with the NRC in a meeting on March 29, 1985.

Attached is a description of models used by Exxon Nuclear to analyze the D. C. Cook 1 Plant prior to determination of coding misformulation and a description of models used after the coding misformulation was corrected. These corrected models provide part of the basis for your current operation. The descriptions are structured to be included as a part of an NRC submission.

Please contact us if you have any questions regarding this attachment.

Very truly yours,

H. G. Shaw
Contract Administrator

tlm

Attachment

c: M. P. Alexich
J. M. Cleveland

Table 1 D.C. Cook Unit 1 LOCA/ECCS Model Summary

		Prior Analysis	Prior Analysis	Current* Analysis
1)	Fission Gas Release Model	WREM-II	EXEM	EXEM
2)	Stored Energy Model	WREM	EXEM	EXEM
3)	Blowdown Model	WREM	WREM	WREM
4)	Containment Model	WREM-II	WREM-II	WREM-II
5)	Clad Swelling and Rupture Model	WREM-II	EXEM	EXEM
6)	Reflood Model			
	a) Carryout and Quench Correlation	WREM	WREM	WREM
	b) Downcomer/Upper Plenum Leakage	NO	NO	NO
	c) Break Model	Split CD = 1.0	Split CD = 1.0	Split CD = 1.0
	d) Core Outlet Enthalpy Model	OFF	OFF	OFF
	e) Z-Equivalent Model	OFF	OFF	OFF
7)	Heatup Model			
	a) Steam Cooling Model	WREM	EXEM	EXEM
	b) Heat Transfer Correlation	WREM-II	WREM-II	WREM-II
	c) Mixing Vane Multiplier	OFF	OFF	OFF
	d) Local Peaking Multiplier	OFF	OFF **	OFF
	e) Z-Equivalent Model	WREM	WREM	WREM
	f) Radiation Model	OFF	ON	ON
8)	Documentation of Results	XN-NF-81-07	XN-NF-83-61	Letter, GFO:85:010
		2/12/81	8/3/83	3/22/85

* Current analysis performed to correct error in code TOODEE2.

** This analysis for 48,000 MWD/MTU used a version of the TOODEE2 code which contained an error such that a multiplier was applied when not intended.

Table 2 Exxon Nuclear Company ECCS Models

		Model	Reference
1.	Fission Gas Release Model		
	a. GAPEX	WREM	1
	b. GAPEX with Uncertainties	WREM-II	1, 6
	c. RODEX2	EXEM	13
2.	Stored Energy Model		
	a. GAPEX	WREM	1
	b. RODEX2	EXEM	13
	c. RODEX2 in RELAP4	EXEM	11c, 13
3.	Blowdown Model	WREM	3, 5, 7
4.	Containment Pressure Model		
	a. Dry Containment	WREM	3
	b. Ice Condenser Containment	WREM-II	6, 14
5.	Clad Swelling and Rupture Model		
	a. Exxon Model	WREM	3, 4
	b. Revised Exxon Model	WREM-II	3, 4, 6
	c. Exxon Model including NUREG-0630	EXEM	10
6.	Reflood Model		
	a. RELAP4	WREM	3
	b. REFLEX	EXEM	8
	c. Carryout and Quench Correlations		
	1) 15x15 FLECHT	WREM	2
	2) 17x17 FLECHT	EXEM	11a
	3) 15x15/17x17 FLECHT	EXEM	11b
	d. Downcomer/Upper Plenum Leakage	EXEM	11a
	e. Break Model		
	1) Split Break	EXEM	11a
	2) Guillotine Break	EXEM	11a
	f. Core Outlet Enthalpy Model	EXEM	11a
	g. Z-Equivalent Model		
	1) WREM	WREM	3
	2) EXEM	EXEM	11d

Table 2 (Continued)

7.	Fuel Rod Heatup Model		
	a. TOODEE2	WREM	3
	b. Steam Cooling Model		
	1) WREM	WREM	3, 9
	2) WREM-II	WREM-II	6, 9
	3) EXEM	EXEM	11
	c. Heat Transfer Correlation		
	1) 15x15	WREM	3
	2) 15x15	WREM-II	6
	3) 17x17	EXEM	11a
	4) 15x15/17x17	EXEM	11b
	d. Mixing Vane HTC Multipliers		
	1) Off	WREM	3
	2) EXEM	EXEM	11a
	e. Local Peaking HTC Multipliers	EXEM	11
	1) Off	WREM	3
	2) EXEM	EXEM	11a
	3) D.C. Cook 2	EXEM	16
	f. Z-Equivalent Model		
	1) WREM	WREM	3
	2) EXEM	EXEM	11d
	g. Radiation Model		
	1) WREM	WREM	3
	2) WREM Expanded New Geometries	EXEM	11d
8.	Core Wide Metal-Water Reaction	WREM	15

REFERENCES

1. XN-73-25, "GAPEXX: A Computer Program for Predicting Pellet-to-Cladding Heat Transfer Coefficients," Exxon Nuclear Company, Inc., Richland, WA 99352, August 1973.

2. XN-75-19, "Carryout Rate Fraction Correlation for Pressurized Water Reactors," Exxon Nuclear Company, Inc., Richland, WA 99352; (a) March 24, 1975; (b) Supplement 1, "Statistical Evaluation of the Carryout Rate Fraction," June 1975.

3. XN-75-41, "Exxon Nuclear Company WREM-Based Generic PWR ECCS Evaluation Model," Exxon Nuclear Company, Inc., Richland, WA 99352.

   a. Volume 1, July 25, 1975.

   b. Volume 2, "Model Justification," August 1, 1975.

   c. Supplement 1, "Further Definitions and Justifications to Reflood Heat Transfer Models," August 14, 1975.

   d. Supplement 2, "Supplementary Information Related to Blowdown and Reflood Analysis," August 14, 1975.

   e. Supplement 3, "Supplementary Information Related to Blowdown and Heatup Analysis," August 16, 1975.

   f. Supplement 4, "Supplementary Information Related to Blowdown and Heatup Analysis," August 20, 1975.

   g. Supplement 5, "Supplementary Information Related to Blowdown and Heatup Analysis," October 3, 1975.

   h. Supplement 6, "Supplementary Information Related to Blowdown and Heatup Analysis," October 27, 1975.

   i. Supplement 7, "Supplementary Information," November 9, 1975.

   j. Volume II Appendix A and B, "3-Loop Westinghouse Sample Problem," August 1, 1975.

   k. Volume II Appendix C, "Yankee Rowe Example Problem," August 22, 1975.

   l. Volume II Appendix D, "3-Loop Westinghouse Large Break Example Problem (Using September 26, 1975 Model)," October 2, 1975.

   m. Volume III Revision 2, "Small Break Model," August 20, 1975.

REFERENCES (Continued)

4. XN-75-6, "Flow Blockage Model for LOCA Analysis," Exxon Nuclear Company, Inc., Richland, WA 99352, April 1, 1975.

5. XN-75-43, "Core Physics Methods and Data Used as Input to LOCA Analysis," Exxon Nuclear Company, Inc., Richland, WA 99352, August 1975.

6. XN-76-27(A), "Exxon Nuclear Company WREM-Based Generic PWR ECCS Evaluation Model Update ENC WREM-II," Exxon Nuclear Company, Inc., Richland, WA 99352; (a) March 1977; (b) Supplement 1(A), "Supplementary Information Relating to," March 1977; and (c) Supplement 2(A), "Supplementary Information Relating to," March 1977.

7. XN-76-44, "Revised Nucleate Boiling Lockout for ENC WREM-Based ECCS Evaluation Model," Exxon Nuclear Company, Inc., Richland, WA 99352, September 1976.

8. XN-NF-78-30(A), "Exxon Nuclear Company WREM-Based Generic PWR ECCS Model Updates ENC WREM-IIA," Exxon Nuclear Company, Inc., Richland, WA 99352, May 1979.

9. Letter, G.F. Owsley (Exxon Nuclear Company) to D.F. Ross (USNRC), Subject: TOODEE2 Updates; Letter No. GFO:077:80 dated April 1, 1980.

10. XN-NF-82-07(P)(A), Rev. 1, "Exxon Nuclear Company ECCS Cladding Swelling and Rupture Model," Exxon Nuclear Company, Inc., Richland, WA 99352, November 1982.

11. XN-NF-82-20(P), "Exxon Nuclear Company Evaluation Model EXEM/PWR ECCS Model Updates," Exxon Nuclear Company, Inc., Richland, WA 99352; (a) Revision 1, August 1982; (b) Revision 1, Supp. 1, "Revised FLECHT-Based Reflood Carryover and Heat Transfer Correlations," June 1983; (c) Revision 1, Supp. 2(A), February 1985; (d) Revision 1, Supp. 3, "Response to NRC Request for Additional Information," Draft; (e) Revision 1, Supp. 4(A), "Adjustments to FLECHT-Based Heat Transfer Correlations," July 1984.

12. XN-NF-82-49(P), "Exxon Nuclear Company Evaluation Model - EXEM/PWR Small Break Model," Exxon Nuclear Company, Inc., Richland, WA 99352; (a) June 1982; (b) Supp. 1, "Supplement 1: Responses to NRC Questions," March 1985.

13. XN-NF-81-58(P)(A), Revision 2, Supps. 1 & 2, "RODEX2 Fuel Rod Thermal Response Evaluation Model," Exxon Nuclear Company, Inc., Richland, WA 99352, March 1984.

14. XN-CC-39, Rev. 1, "ICECON: A Computer Program Used to Calculate Containment Back Pressure for LOCA Analysis (Including Ice Condenser Plants)," Exxon Nuclear Company, Inc., Richland, WA 99352, November 1978.

REFERENCES (Continued)

15. XN-CC-36, "Exxon Nuclear Procedure for Calculating Core-Wide Metal-Water Reaction During a Loss-of-Coolant Accident," Exxon Nuclear Company, Inc., Richland, WA 99352, December 1975.

16. Letter, J.C. Chandler (Exxon Nuclear Company) to H.R. Denton (USNRC), Subject: Local Peaking Multiplier for Reflood Heat Transfer Coefficient; Letter No. JCC:076:84 dated May 7, 1984.

EXXON NUCLEAR COMPANY, INC.

600 108TH AVENUE NE P.O. BOX 90777, BELLEVUE, WA 98009
(206) 453-4300

April 2, 1985
ENC-AEP/0437

Mr. George John, Sr. Engineer
Nuclear Materials & Fuel Mgmt.
Indiana & Michigan Electric Co.
c/o American Electric Power Service Corp.
One Riverside Plaza
Columbus, OH 43216-6631

Dear Mr. John:

This information is provided to you in accordance with Exxon Nuclear's agreement with the NRC in a meeting on March 29, 1985.

Attached for your use in transmittal to the NRC is a description of the models used by Exxon Nuclear to analyze the D. C. Cook 2 Plant which provide part of the current basis for your operation.

Please contact us if you have any questions concerning this attachment.

Very truly yours,

H. G. Shaw
Contract Administrator

tlm

Attachment

c: M. P. Alexich
J. M. Cleveland

RAPIFAX NO. 452
PAGE 1 OF 7

Table 1 D.C. Cook Unit 2 LOCA/ECCS Model Summary

		Prior Analysis	Prior Analysis+	Current Analysis++
1)	Fission Gas Release Model	EXEM	EXEM	EXEM
2)	Stored Energy Model	EXEM	EXEM	EXEM/RELAP4
3)	Blowdown Model	WREM	WREM	WREM
4)	Containment Model	WREM-II	WREM-II	WREM-II
5)	Clad Swelling and Rupture Model	EXEM	EXEM	EXEM
6)	Reflood Model			
	a) Carryout and Quench Correlation	EXEM	EXEM	EXEM
	b) Downcomer/Upper Plenum Leakage	Yes (EXEM)	Yes (EXEM)	Yes (EXEM)
	c) Break Model	Guillotine CD = 1.0	Guillotine CD = 1.0	Guillotine CD = 1.0
	d) Core Outlet Enthalpy Model	EXEM	EXEM	EXEM
	e) Z-Equivalent Model	OFF	OFF	EXEM
7)	Heatup Model			
	a) Steam Cooling Model	EXEM	EXEM	EXEM
	b) Heat Transfer Correlation	EXEM*	EXEM*	EXEM*
	c) Mixing Vane Multiplier	1.0	1.0	1.0
	d) Local Peaking Multiplier	~~1.15~~ **	~~1.15~~**	~~1.15~~**
	e) Z-Equivalent Model	WREM	EXEM	EXEM
	f) Radiation Model	ON	ON	ON
8)	Documentation of Results	XN-NF-84-21 (P) Rev. 1 5/22/84	XN-NF-84-21 (P) Rev. 2 8/7/84	Not Issued Yet (XN-NF-84-21(P), Rev. 2 Supp.

* 17x17 FLECHT Correlation

** Core height and time dependent multiplier used.

\+ Models used for administrative limit in place as of April 3, 1985. Item 8 only documents chopped cosine, but 4/3/85 administrative limit accounts for other power distributions not included in Item 8 reference.

++ Models used for new analysis recorrelating existing FLECHT data to account for peaks at the top of the core.

Table 2 Exxon Nuclear Company ECCS Models

		Model	Reference
1.	Fission Gas Release Model		
	a. GAPEX	WREM	1
	b. GAPEX with Uncertainties	WREM-II	1, 6
	c. RODEX2	EXEM	13
2.	Stored Energy Model		
	a. GAPEX	WREM	1
	b. RODEX2	EXEM	13
	c. RODEX2 in RELAP4	EXEM	11c, 13
3.	Blowdown Model	WREM	3, 5, 7
4.	Containment Pressure Model		
	a. Dry Containment	WREM	3
	b. Ice Condenser Containment	WREM-II	6, 14
5.	Clad Swelling and Rupture Model		
	a. Exxon Model	WREM	3, 4
	b. Revised Exxon Model	WREM-II	3, 4, 6
	c. Exxon Model including NUREG-0630	EXEM	10
6.	Reflood Model		
	a. RELAP4	WREM	3
	b. REFLEX	EXEM	8
	c. Carryout and Quench Correlations		
	1) 15x15 FLECHT	WREM	2
	2) 17x17 FLECHT	EXEM	11a
	3) 15x15/17x17 FLECHT	EXEM	11b
	d. Downcomer/Upper Plenum Leakage	EXEM	11a
	e. Break Model		
	1) Split Break	EXEM	11a
	2) Guillotine Break	EXEM	11a
	f. Core Outlet Enthalpy Model	EXEM	11a
	g. Z-Equivalent Model		
	1) WREM	WREM	3
	2) EXEM	EXEM	11d

Table 2 (Continued)

7.	Fuel Rod Heatup Model		
	a. TOODEE2	WREM	3
	b. Steam Cooling Model		
	1) WREM	WREM	3, 9
	2) WREM-II	WREM-II	6, 9
	3) EXEM	EXEM	11
	c. Heat Transfer Correlation		
	1) 15x15	WREM	3
	2) 15x15	WREM-II	6
	3) 17x17	EXEM	11a
	4) 15x15/17x17	EXEM	11b
	d. Mixing Vane HTC Multipliers		
	1) Off	WREM	3
	2) EXEM	EXEM	11a
	e. Local Peaking HTC Multipliers	EXEM	11
	1) Off	WREM	3
	2) EXEM	EXEM	11a
	3) D.C. Cook 2	EXEM	16
	f. Z-Equivalent Model		
	1) WREM	WREM	3
	2) EXEM	EXEM	11d
	g. Radiation Model		
	1) WREM	WREM	3
	2) WREM Expanded New Geometries	EXEM	11d
8.	Core Wide Metal-Water Reaction	WREM	15

REFERENCES

1. XN-73-25, "GAPEXX: A Computer Program for Predicting Pellet-to-Cladding Heat Transfer Coefficients," Exxon Nuclear Company, Inc., Richland, WA 99352, August 1973.

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   c. Supplement 1, "Further Definitions and Justifications to Reflood Heat Transfer Models," August 14, 1975.

   d. Supplement 2, "Supplementary Information Related to Blowdown and Reflood Analysis," August 14, 1975.

   e. Supplement 3, "Supplementary Information Related to Blowdown and Heatup Analysis," August 16, 1975.

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   k. Volume II Appendix C, "Yankee Rowe Example Problem," August 22, 1975.

   l. Volume II Appendix D, "3-Loop Westinghouse Large Break Example Problem (Using September 26, 1975 Model)," October 2, 1975.

   m. Volume III Revision 2, "Small Break Model," August 20, 1975.

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