ATTACHMENT 4

Westinghouse Electric Corporation | **Water Reactor Divisions**

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230

August 7, 1984
CAW-84-58

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20055

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

REFERENCE: Duke Power Company letter to NRC dated March 1984

Dear Mr. Denton:

The proprietary material for which withholding is being requested in the reference letter by Virginia Electric and Power Company is further identified in an affidavit signed by the owner of the proprietary information, Westinghouse Electric Corporation. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10CFR Section 2.790 of the Commission's regulations.

The proprietary material for which withholding is being requested is of the same technical type as that proprietary material previously submitted with application for withholding AW-76-31.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Virginia Electric and Power Company.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-84-58, and should be addressed to the undersigned.

Very truly yours,

Robert A. Wiesemann

Robert A. Wiesemann, Manager
Regulatory & Legislative Affairs

/pj
cc: E. C. Shomaker, Esq.
Office of the Executive Legal Director, NRC

AW-76-31

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF ALLEGHENY:

Before me, the undersigned authority, personally appeared Robert A. Wiesemann, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Corporation ("Westinghouse") and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Robert A. Wiesemann

Robert A. Wiesemann, Manager
Licensing Programs

Sworn to and subscribed before me this 5 day of July 1976.

Notary Public

RC ...IC

... COUNTY
MY COMMISSION EXPIRES APR. 15, 1978

(1) I am Manager, Licensing Programs, in the Pressurized Water Reactor Systems Division, of Westinghouse Electric Corporation and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing or rule-making proceedings, and am authorized to apply for its withholding on behalf of the Westinghouse Water Reactor Divisions.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.790 of the Commission's regulations and in conjunction with the Westinghouse application for withholding accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse Nuclear Energy Systems in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.790 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

   (i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitutes Westinghouse policy and provides the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(g) It is not the property of Westinghouse, but must be treated as proprietary by Westinghouse according to agreements with the owner.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information which is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition in those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.790, it is to be received in confidence by the Commission.

(iv) The information is not available in public sources to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in the attachment to Westinghouse letter No. NS-CE-1142, Eicheldinger to Eisenhut dated July 27, 1976 concerning reproductions of view-graphs used in the Westinghouse presentation to the NRC during the meeting on July 27, 1976 on the subject of Westinghouse Reload Safety Evaluation Methodology.

This information enables Westinghouse to:

(a) Justify the design for the reload core

(b) Assist its customers to obtain licenses

(c) Meet contractual requirements

(d) Provide greater flexibility to customers assuring them of safe and reliable operation.

Further, this information has substantial commercial value as follows:

(a) Westinghouse sells the use of the information to its customers for purposes of meeting NRC requirements for licensing documentation.

(b) Westinghouse uses the information to perform and justify analyses which are sold to customers.

(c) Westinghouse uses the information to sell nuclear fuel and related services to its customers.

Public disclosure of this information is likely to cause substantial harm to the competitive position of Westinghouse in selling nuclear fuel and related services.

Westinghouse retains a marketing advantage by virtue of the knowledge, experience and competence it has gained through long involvement and considerable investment in all aspects of the nuclear power generation industry. In particular Westinghouse has developed a unique understanding of the factors and parameters which are variable in the process of design of nuclear fuel and which do affect the in service performance of the fuel and its suitability for the purpose for which it was provided.

In all cases that purpose is to generate energy in a safe and efficient manner while enabling the operating nuclear generating station to meet all regulatory requirements affected by the core loading of nuclear fuel. Confidence in being able to accomplish this comes from the exercise of judgement based on experience.

Thus, the essence of the competitive advantage in this field lies in an understanding of which analyses should be performed and in the methods and models used to perform these analyses. A substantial part of this competitive advantage will be lost if the competitors of Westinghouse are able to use the results of the Westinghouse experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions. Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design and licensing of a similar product.

This information is a product of Westinghouse design technology. As such, it is broadly applicable to the sale and licensing of fuel in pressurized water reactors. The development of this information is the result of many years of Westinghouse effort and the expenditure of a considerable sum of money. In order for competitors of Westinghouse to duplicate this process would require the investment of substantially the same amount of effort and expertise that Westinghouse possesses and which was acquired over a period of more than fifteen years and by the investment of millions of dollars.

Further the deponent sayeth not.

ATTACHMENT 1

III. VEPCO RETRAN CONTROL SYSTEM MODELS DESCRIPTION/QUALIFICATION

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Vepco's RETRAN models make extensive use of the RETRAN control system modeling capability. The control system feature is used in the following areas:

1. modeling certain features of the reactor protection system. These use signals which are generated by the operation of analog computer elements on various process signals (e.g., the temperature and overpower delta-T trips).
2. modeling certain aspects of the reactor plant control systems which may significantly influence the course of a transient (examples are the pressurizer pressure control system, the turbine governer valve (electrohydraulic) control system and the secondary steam dumps).
3. special submodels which calculate time-dependent boundary conditions or forcing functions which involve several sequential arithmetic operations. The only application of this type which Vepco currrently makes is to a model to describe the transport and mixing of boron in the RCS following a safety injection.

The paragraphs below describe the various models, their development, use and qualification, where appropriate. Each model is also presented in terms of a block diagram which shows the interrelationships between variables and operations and also describes the interface between the control model and the rest of the system model.

Figures III-1 and III-2 show the overtemperature delta-T reactor trip and the overpower delta-T reactor trip, respectively. Normally, no credit is taken for the overpower delta-T trip feature, and the trip is disabled with a long delay on the corresponding trip card. The overtemperature delta-T logic calculates a delta-T setpoint based on measured average temperature and pressure. The final control block in the sequence differences the actual delta-T with the calculated setpoint. When the difference becomes positive, a reactor trip signal is generated (after an appropriate time delay to account for signal processing delays, etc.). The calculated setpoint conservatively reflects the various processing and setpoint errors. The model has been qualified by comparison of calculated steady-state trip setpoints to hand calculations, and by comparing the calculated time to trip during rod withdrawal transients with FSAR results and with alternate calculations.

Figure III-3 presents the pressurizer pressure control model used by Vepco. The model represents a proportional-plus-integral controller, the output of which drives the pressurizer heaters and spray. The linear variation of spray valve position with controller output is modelled by a weighted summer. Spray flow rate is calculated from the valve position and the loop flow fraction, since the driving force for the spray is the dynamic head of reactor coolant in the cold leg. The controller output is also used to trip the pressurizer heaters on and off, and to open and close one of the two pressurizer power operated relief valves (the other valve is controlled directly from pressurizer pressure). The controller gain and time constant are taken from plant operating documents. The reference pressure is adjusted up or down during safety analyses as appropriate, to reflect steady state pressure measurement errors.

An example of a comparison of a RETRAN calculated pressure response with the pressure control system assumed to be functional to FSAR results is shown in Figure 5.10 of the topical report. Comparisons with Vepco-generated results using an alternate method are presented and discussed in Section V of this supplement.

Figures III-4 and III-5 illustrate how the pressurizer pressure and steam pressure, respectively, are filtered before passing the signals to the reactor trip and engineered safeguards (safety injection) systems. The lead and lag time constants are best estimate values, taken from plant setpoint documentation.

Figure III-6 illustrates how the control system function generator feature is used to generate power feedback reactivity. This method of representing the reactivity feedback is used in situations where power is varying slowly enough that a defined relationship between power and fuel temperature exists. In most cases the independent variable is taken as the neutron power. For steam line break calculations, where the system returns to power from a subcritical condition, using neutron power as the independent variable could lead to calculational instabilities in the vicinity of the initial power 'jump' following a return to power. For this reason, the heat flux is used as the input variable for steambreak calculations. For transients where the neutron power is varying rapidly (e.g., rod withdrawal from subcritical) the power reactivity concept is not applicable, and doppler feedback is represented as a function of fuel temperature.

Figure III-7 shows how main steam line isolation valve closure following a steam line break is modelled. This model allows the initial opening of the break and the closure of the isolation valve to be modelled at the same junction. The upper integrator simulates the opening of the break in 0.01 seconds. The lower integrator recloses the break path upon reciept of a signal from the trips which model the engineered safety features. The closure time is the maximum allowable value from the technical specifications.

Figure III-8 shows how control blocks are arranged to calculate a region-weighted moderator temperature for use in steam line break calculations. Since point kinetics is used, consistent with vendor methodology, a radial moderator temperature weighting factor is used to approximate the effects of the coldest water entering the core region containing a stuck rod. The function generator allows representation of a nonlinear variation of reactivity with moderator temperature.

Figure III-9 represents the core average heat flux calculation performed in the two loop model. This heat flux is expressed in terms of fraction of the rated full power value, and is used for editing purposes, and to drive the power reactivity feedback calculation described in Figure III-6 during steamline break calculations.

A few of the accidents which may require RETRAN analysis are affected by the turbine governor valve (or electrohydraulic control-EHC) system. A simple control system model is used to describe the effects of this system on steam flow to the turbine; this model is shown in Figure III-10. The model assumes that steam flow is constant with decreasing pressure until the governor valves reach a full open position. Thereafter, steam flow is assumed to decrease linearly with pressure.

Certain best estimate calculations (e.g. the analysis of the North Anna cooldown event discussed in Section 5.3.3 of the topical report), require a representation of the secondary steam dump system. Figure III-11 shows the arrangement of control blocks used to calculate steam dump flow area as a function of average temperature. Following a turbine trip, the steam dumps rapidly trip open to provide load rejection capability for the system. The valves then modulate closed as the measured average coolant temperature decreases and approaches the no-load value. Values for the no-load reference temperature, Tref, the filter time constants T1 and T2 and the program for dump capacity vs (Tavg - Tref) are all taken from current plant setpoint documents. For the North Anna cooldown event, initial post-trip cooldown rates calculated with this model agreed well with observed trends.

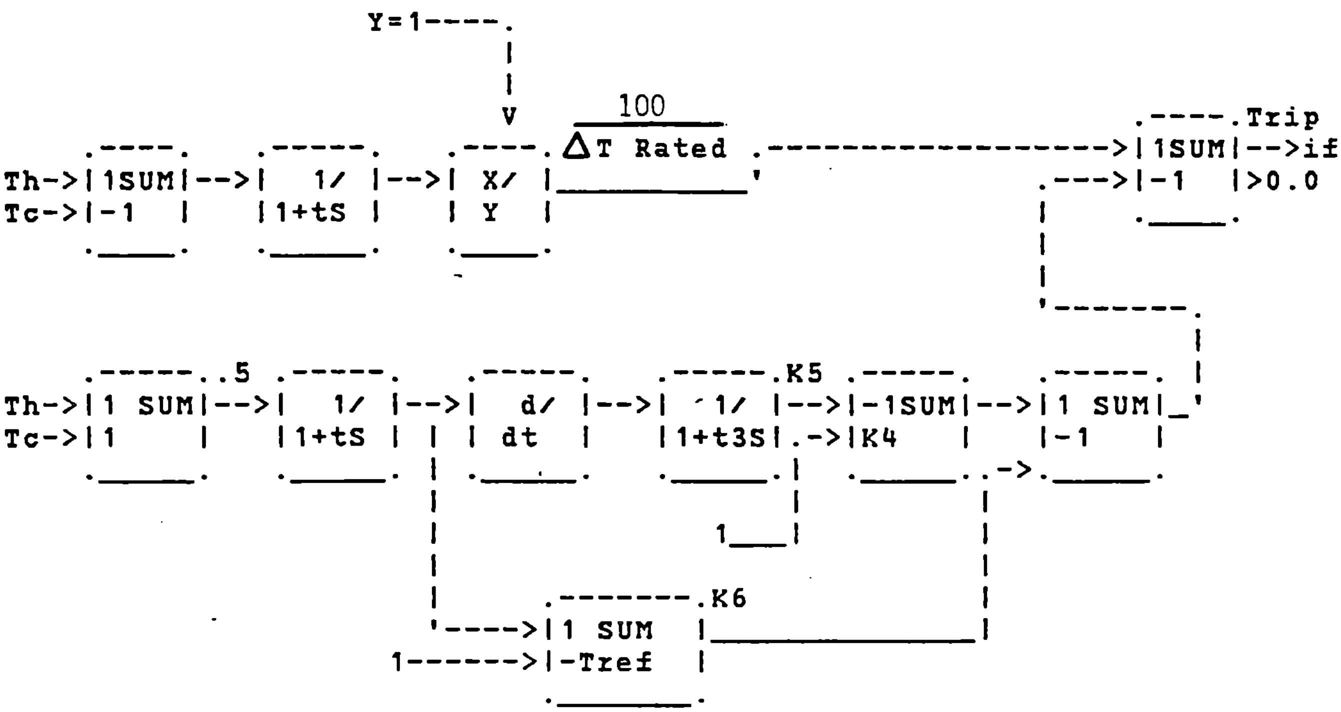
The RETRAN submodel for calculating the mixing and transport of high boron concentration water from safety injection into and around the primary coolant loops is shown in Figure III-12. The model shown is appropriate for full flow conditions in all loops. Pipe-like regions of the system are treated with delay control blocks. Plena are treated with a first order lag. The delay times and time constants are calculated from the nodal fill times for the various regions. Time dependent core boron concentrations obtained with this model agree reasonably well with results obtained with hand calculations and simpler, RCS-average mixing assumptions.

FIGURE III-1
OVERTEMPERATURE DELTA-T TRIP

```
                          Y=1------
                                  |
                                  |
                                  V        100                                       .------.Trip
           .----.    .-----.    .----.   ΔT Rated.  ------------------------->|1 SUM |->if
--Th---->  |1SUM|-->|  1/  |-->| X/ |-----------'                        .>|-1     |>0.0
|     .-->  |-1  |    |1+t1S|    | Y  |                                     |  .______.
|      Tc   .____.    .______.   .____.                                     |
|      |                                                                    |
|    ._|                                                                    '-------------.
|    |                                                                                    |
|    |    .------..5 .-----.    .-----.K2  .-----.    .-----.    .-----.                 |
|    '----->|1 SUM|-->|  1/  |-->|1 SUM|-->|1+t3S|-->|-1SUM|-->|1 SUM|_______________|
'--------->|1     |   |1+t2S| .>|-Tref|   |1+t4S|.->|K1    | .>|1     |
           .______.   .______. |.______.  .______.|  .____.| |  .______.
                               |                  |          |
                          1____|            1 ____|          |
                                                             |
                                       Gain = K3             |
                                       .-------.             |
                             P------>|1 SUM  |______________|
                             1------>|-Pref  |
                                       .________.
```

$$\text{Trip if } \frac{\Delta T \times 100}{\Delta T \text{ Rated}} > K1 - K2 \frac{(1+t3S)}{(1+t4S)}(Tavg - Tref) + K3\,(P-Pref)$$

FIGURE III-2
OVERPOWER DELTA-T TRIP



$$\text{Trip if } \frac{\Delta T \times 100}{\Delta T \text{ Rated}} > K4 - K5 \; \frac{t3S}{1+t3S} \; Tavg - K6\,(Tavg - Tref)$$

FIGURE III-3
LOGIC FOR PRESSURE CONTROL SYSTEM

```
                       .-
                .---> |Trip No. 4(-4)
                |     |Heaters on if <A%.      off if >A%*
                |     ._
                |     .-
                |     |Trip No. 9 (-9)
BISTABLES--->   |---> |Open Power Operated Relief Valve #2
   |            |     |>B% Close if <B%*
   |            |     ._
   |            '-------------------------------------------.
   |                  .-                                     |
   |                  |Trip No. 8 (-8)                       |
   |      .---------> |Open Power Operated Relief Valve      |
   '-->   |           |#1 if >C, close if <C*                |
          |           ._                                     |
          |                                1/T               |
        .---------.  .-----.    .------.     .-------.       |
Controller |Pressure|---->|1.SUM|---->| INT  |---->|1. SUM |->-|
Unit------> |        |  .->|-PREF|  |  |      |  .-->|1.     |   |
        .________.  |  .______.  |  .______.  |  .________.   |
          1.0------'             |___________|                |
      .--------------------<---------------------------------'
      |
      |                             Gain=Full Spray/
      |    .-----.Max=1.0   .------.  Loop Flow     --  --
Spray Valve '-->|1.SUM|---------->|1.0MUL|------------->|Fill|
Controller-->   |-Y** |       .-->|1.0   |     |        | #  |-->Spray
           ._____.Min=0.0|    .______.     |        | 1  |Junction (19)
                         |                 |        --  --
                         |                 |       Gain=-1
Cold Leg Flow       _____|                 |   .-----.    --    --
                                           '-->|1.    |-->|Fill |Spray
                                   1.0--->| MUL |    |#    |Intake
                                           .______.    |2    |(18)
                                                       --    --
```

* Setpoints A, B and C are best estimate values taken from plant setpoint documents.

** The parameter "Y" in the summer block for the spray valve controller is a measure of the difference between the pressure at which the spray valves begin to open and the reference pressure. "T" is the pressure controller reset time constant.

Figure III-4
LOW PRESSURE TRIP SIGNAL

```
                               .----------.
                               |          |
PRESSURIZER ------------->|  1+T1S    |-------> TO REACTOR TRIP
PRESSURE                       |  ______  |         ON LOW PRESSURE
                               |  1+T2S   |
                               .__________.
```

T1 = LEAD TIME CONSTANT
T2 = LAG TIME CONSTANT
S = LAPLACE TRANSFORM VARIABLE

TIME CONSTANTS ARE TAKEN FROM PLANT SETPOINT DOCUMENT
LOW PRESSURE TRIP SETPOINT IS THE SAFETY ANALYSIS VALUE
(INCLUDES UNCERTAINTIES)

SEE ALSO SINGLE LOOP MODEL TRIP DESCRIPTION IN SECTION I.

FIGURE III-5
LOW STEAM PRESSURE SIGNAL

```
                               .----------.
                               |          |
FAULTED LOOP------------->|  1+T1S   |--------> TO SAFETY INJECTION
STEAM PRESSURE                 |  _____   |          LOGIC
                               |  1+T2S   |
                               .__________.
```

T1 = LEAD TIME CONSTANT
T2 = LAG TIME CONSTANT
S = LAPLACE TRANSFORM VARIABLE

TIME CONSTANTS ARE TAKEN FROM PLANT SETPOINT DOCUMENT
LOW PRESSURE SETPOINT IS THE SAFETY ANALYSIS VALUE
(INCLUDES UNCERTAINTIES)

SEE ALSO TWO LOOP MODEL TRIP DESCRIPTION IN SECTION 1.

FIGURE III-6
POWER REACTIVITY FEEDBACK FUNCTION

```
                                          .---------.
CORE AVERAGE HEAT FLUX------------>|         |
       OR                          |   FNG   |
NORMALIZED-----> X INITIAL------->|         |---->POWER    --->TO
POWER               % POWER       .__________.    REACTIVITY  KINETICS
                 (GAIN FACTOR)          |          ($)        TABLES
                                        |
                                        |
      TABLE OF POWER REACTIVITY---------
        VS. POWER IN $
```

SEE ALSO "DOPPLER POWER COEFFICIENT" DESCRIPTION IN SECTION IV-
"INPUT OPTIONS"

FIGURE III-7
SIMULATION OF MAIN STEAM ISOLATION VALVE CLOSURE
FOR STEAMLINE BREAK CALCULATIONS

```
                                 .-------.GAIN=100
                                 |       |MAX=1.0             .-----.MAX=1.0
TRIP TO INITIATE------->| INT   |------------------>|+1    |        VALVE
BREAK (0 OR 1)                   |       |                     | SUM | ----> AREA
                                 ._______.              .---->|-1    |        TABLE
                                                        |      ._____.MIN=0.0
                                                        |
HIGH STEAM FLOW/                                        |
LOW TAVE                                          .-------. MAX = 1.0
    OR          -->TIME--->MAIN STEAM------>|       | GAIN = 1/T1
HIGH STEAM FLOW/ DELAY    ISOLATION          | INT   | T1=CLOSURE TIME
LOW PRESSURE              SIGNAL (0 OR 1)    ._______.
```

SEE ALSO "MAIN STEAM ISOLATION VALVES" IN SECTION II - COMPONENT MODELS AND TWO LOOP MODEL TRIP DESCRIPTION IN SECTION I - VOLUME AND FLOW PATH NETWORK DESCRIPTION.

THIS LOGIC APPLIES ONLY TO THE "INTACT" LOOP DURING A MAIN STEAM LINE BREAK.

FIGURE III-8
MODERATOR TEMPERATURE DEFECT CALCULATION (TWO LOOP MODEL)

```
        .-----.              .------.GAIN1            .------.
T113--->|     |              |      |                 |      |<--T115
T114--->| SUM |------------->| SUM  |<----------------| SUM  |<--T116
        ._____.              .______.                 .______.
                                |    .----------.
                                |    |REACTIVITY|
                                |    |    VS    |
                                |    |MOD TEMP  |
                                |    .__________.
                             .--V---.     |       .------.
                             |      |     '------>|      |      TO
                             | SUM  |------------>| FNG  |---->REACTIVITY
                             .__^___.             .______.      TABLES
                                |
        .-----.              .--|---. GAIN2           .------.
T213--->|     |              |      |                 |      |<--T215
T214--->| SUM |------------->| SUM  |<----------------| SUM  |<--T216
        ._____.              .______.                 .______.
```

TXXX = MODERATOR TEMPERATURE IN VOLUME XXX
GAIN1 = RMWF/4
GAIN2 = (1-RMWF)/4
RMWF = RADIAL MODERATOR TEMPERATURE WEIGHTING FACTOR

SEE ALSO THE GENERALIZED DATA TABLE DESCRIPTION FOR MODERATOR TEMPERATURE DEFECT IN SECTION IV - INPUT OPTIONS, AND THE TWO LOOP MODEL CONTROL VOLUME DESCRIPTION IN SECTION I - VOLUME AND FLOW PATH NETWORK DESCRIPTION.

FIGURE III-9
CORE HEAT FLUX CALCULATION (TWO LOOP MODEL)

```
       .-----.            .------.                    .------.
Q101--->|     |            |      |                    |      |<--Q103
Q102--->| SUM |----------->| SUM  |<------------------ | SUM  |<--Q104
       .______.           .______.                    .______.
                               |
                               |
                               |
                               |
                               |
                          .--V---. GAIN
                          |      |
                          | SUM  |-----> CORE AVERAGE HEAT FLUX
                          .__^___.              FOR MINOR EDITS
       .-----.            .------.                    .------.
Q201--->|     |            |      |                    |      |<--Q203
Q202--->| SUM |----------->| SUM  |<------------------ | SUM  |<--Q204
       .______.           .______.                    .______.
```

QXXX = POWER TO WATER FROM CONDUCTOR XXX, BTU/HR
GAIN = CONVERSION FACTOR, BTU/HR TO FRACTION OF RATED POWER

SEE ALSO TWO LOOP MODEL HEAT CONDUCTOR DESCRIPTION IN SECTION 1

FIGURE III-10
SIMULATION OF ELECTROHYDRAULIC TURBINE CONTROL SYSTEM

```
.----------------------.
|GENERAL DATA TABLE    |
|STEAM FLOW VS STEAM   |
|PRESSURE FOR FULL-OPEN|          .--------.
|THROTTLE CONDITIONS   |------->|        |
.______________________.   .-->|  FNG   |--.    .-------.
                           |   .________.  '-->|       |---->STEAM FLOW
 STEAM PRESSURE------------                  .-->|  MIN  |     FILL TABLE
                               .--------.   |   ._______.
 TIME------------------------->|        |--'
                           .-->|  FNG   |
.----------------------.   |   .________.
|GENERAL DATA TABLE    |----
|STEAM DEMAND VS TIME  |
.______________________.
```

SEE ALSO THE MAIN STEAM FLOW FILL TABLE DESCRIPTION IN SECTION IV.

FIGURE III-11

STEAM DUMP CONTROLLER - BEST ESTIMATE ANALYSES

```
        .-------.GAIN=.5     .--------.     .--------.
THOT-->|       |--------->|+1       |---->| 1+T1S  |
TCOLD->|  SUM  |    TREF-->|-1 SUM   |     | ------ |
       .______.            .________.     | 1+T2S  |
                                          .________.
                                               |
                                           FILTERED
                                          (TAVE-TREF)
                                               |
                                               V
                                           .--------.
              TABLE OF DUMP CAPACITY      |        |
                  VS (TAVE-TREF)------->| FNG    |
                                          |        |
                                          .________.       .--------.
                      .------.GAIN= 100.       |           |        |
                      |      |MAX=1.0          '--------->|  MUL   |
  TURBINE TRIP------>|INT   |------------------------->|        |
  SIGNAL (0 OR 1)     |      |                             .________.
                      .______.                                 |
                                                               |
                                                               V
                                                         TO VALVE AREA
                                                             TABLE
```

THIS FEATURE IS NOT USED IN SAFETY ANALYSES, WHICH TAKE NO CREDIT FOR THE LOAD REJECTION CAPABILITY ASSOCIATED WITH STEAM DUMP. THE FEATURE IS USED IN SOME BEST ESTIMATE ANALYSES, SUCH AS THE ANALYSIS OF THE NORTH ANNA COOLDOWN EVENT DISCUSSED IN SECTION 5.3.3 OF THE TOPICAL REPORT.

FIGURE III-12
BOROM TRANSPORT MODEL

```
                                         Gain=100000000         Gain=1/60
                                        .-------. Max=1.0      .-----.
                   .----.. Integrated-->|1 SUM |------------->| MUL |
Safety Inj. ---->|INT |--Volume     ->|-Vpurg|           .->|     |
 Flow, gpm         .____.             | .______.Min=0.0    |  .______.
     |                           1.0-'                     |     |
     |_____________________________________________________|     |
                   Gain=1/VBIT                                    |
                   .----.    .-----.    .-----.                   |
              .-->|INT |--->| XPO |---->|C2SUM|--->Boron conc. exiting
              |    .____.  .>|     |  .->|C1   |    Boron Injection Tank
              |       "e"-'  .______.  |  .______.                |   |
              |                  1.0--'                           V   V
   .-------'---------------------------------------<-------------'   |
   |                                                                   |
   | .----------------------------------------------------------------'
   | '>.---.  G1.---.    .---.    .---.    .---.   .---.   .---.
   |    |MUL|--->|SUM|-->|DLY|-->|LAG|-->|DLY|->|DLY|->|LAG|6
   '-->.___. -->.___.    .___.    .___.    .___.|  .___.   .___.
       .-----'    1        2        3        4  |   5       |   Boron
       |                                        '-----------V-->at core
       | .---.  .---.  .---.  .---.  .---.  .---.       .---. midplane
       '-|DLY|<-|LAG|<-|DLY|<-|LAG|<-|DLY|<-|LAG|<-----|DLY|7
         .___.  .___.  .___.  .___.  .___.  .___.       .___.
          13     12     11     10      9      8
```

Region Numbers:

1- cold leg mixing zone
2- cold leg/downcomer
3- bottom plenum
4- bottom core
5- top core
6- outlet plenum
7- hot leg
8- steam generator inlet plenum
9- steam generator tubes
10- steam gen. outlet plenum
11- cold leg 1
12- pump
13- cold leg 2 (pump outlet to mixing zone)

ATTACHMENT 3

V. COMPARISON TO ALTERNATE CODE CALCULATIONS

(NON-PROPRIETARY)

V. COMPARISON TO ALTERNATE CODE CALCULATIONS

In the topical report (VEP-FRD-41), Vepco provided numerous comparisons of transient results obtained with our RETRAN models to licensing results obtained by the NSSS/fuel vendor for Vepco's units. The latter were performed primarily to support the FSAR's and subsequent reload safety evaluations. This section provides a supplement to those comparisons in the form of parallel calculations performed by Vepco using both a standard Vepco RETRAN model and a corresponding LOFTRAN model. The LOFTRAN code is a proprietary code developed and maintained by the Westinghouse Electric Corporation for use in performing general non-LOCA accident analyses. Vepco has had access to LOFTRAN for four years via a special licensing agreement with Westinghouse. A detailed description of the LOFTRAN code is given in Reference V-1.

Vepco safety analysis engineers have undergone extensive training in the use of Westinghouse core design and safety analysis codes, including formal classroom instruction by Westinghouse (see Table V-1) and on-the job-training at Westinghouse and/or Vepco. Part of this training included a formal forty-hour non-LOCA safety analysis course which covered theory, input preparation and applications of LOFTRAN. Surry and North Anna specific models have been assembled in-house by Vepco.

The comparisons shown here were performed with a LOFTRAN model of the Surry reactors assembled by Vepco using the same data base used for development of the RETRAN models. Thus the basic plant geometric and thermal parameters are consistent for the two models. Initial conditions such as [ ][a,c] were [ ][a,c] from the use of [ ][a,c] in the two codes to represent the equations of state for the coolant, etc.). Comparison of steady state conditions for the two codes are provided in Table V-2. Table V-3 provides a description of the three transients used in the comparisons. Discussions of the comparisons are given in the paragraphs below.

TRAINING
WESTINGHOUSE DESIGN AND SAFETY ANALYSIS CODES AND METHODOLOGY

COURSE DESCRIPTION	COURSE LENGTH	NUMBER OF PRESENTATIONS	TOTAL TRAINING
INTRODUCTION TO THE W COMPUTER SYSTEM	3 DAYS	2	39 MAN-DAY
BASIC PWR CORE PHYSICS AND THERMAL HYDRAULICS	5 DAYS	1	35 MAN-DAYS
METHDOLOGY AND COMPUTER MODELS FOR W DESIGN CODES	5 DAYS	3	80 MAN-DAYS
WESTINGHOUSE DESIGN CODES	5 DAYS	2	60 MAN-DAYS
NUCLEAR DESIGN DEVELOPMENT OF THE RELOAD SAFETY ANALYSIS CHECKLIST	5 DAYS	3	115 MAN-DA
INTRODUCTION TO NON-LOCA SAFETY ANALYSIS	5 DAYS	3	80 MAN-DAY
ROD EJECTION, MAIN STEAMLINE BREAK, DROPPED ROD ANALYSIS	5 DAYS	2	40 MAN-DAY
WESTINGHOUSE THERMAL HYDRAULIC METHODS	5 DAYS	1	20 MAN-DAY
WESTINGHOUSE LARGE BREAK LOCA CODES (THEORY)	5 DAYS	2	30 MAN-DA
WESTINGHOUSE LARGE BREAK LOCA CODES (ON-THE-JOB TRAINING)	20 DAYS	3	60 MAN-DA
		TOTAL	559 MAN-DA

TABLE V-2

COMPARISON OF RETRAN/LOFTRAN CALCULATED STEADY STATE CONDITIONS

a,c

Parameter	RETRAN Value
Core power, mwt	2489.82 -S
Pump heat, mwt	12.15 -C
Tcold, °F	547.11 (after pump) -S* 546.68 (before pump) -C*
Thot, °F	610.15 -C
Tavg, °F	578.63 -C
Steam Flow, lb/sec	3017.5 -S
Steam Pressure, psia	785.0 -S
Steam generator inventory, lbm	313200 -S
Feedwater enthalpy, btu/lbm	413.69 -C
Steam Enthalpy, btu/lbm	1199.7 -C
Average fuel temperature, °F	1405.7 -C

'C' denotes a code calculated parameter
'S' denotes a parameter specified as input

TABLE V-3
RETRAN/LOFTRAN Transient Comparisons

Case	Description
1	Reactor trip from hot full power followed by a turbine trip.
2	Turbine trip from hot full power. No credit taken for direct reactor trip on the turbine trip. Pressurizer sprays, PORV's and steam generator relief valves are assumed available.
3	Simultaneous trip of all three reactor coolant pumps at hot full power. No credit taken for reactor trip on pump undervoltage or underfrequency. Pressurizer sprays, PORV's and steam generator relief valves are assumed available.

REACTOR TRIP

Figures V-1 to V-4 show the results for the reactor trip. Figure V-1 presents the core response in terms of nuclear power, fuel temperature and core heat flux. As the results show, the core neutron and thermal kinetics models for the two codes give results which are [ ]a,c

Figure V-2 compares the steam generator response in terms of steam pressure and primary to secondary heat transfer, or heat extraction, rate. The response of the reactor coolant system is shown in Figures V-3 (RCS average temperature) and V-4 (pressurizer water volume and pressure). The RCS average temperature response [ ]a,c In RETRAN, the temperature at a specific location is input (in this case the cold leg) and the average temperature is then calculated based on the steady state initialization results. In Figure V-4, about [ ]a,c

TURBINE TRIP

Figures V-5 to V-8 show the comparisons for the turbine trip without direct reactor trip. The results are shown out to the time of reactor trip, and present steam pressure, reactor inlet temperature, reactor power and pressurizer pressure, respectively. Figure V-7 is of interest in that it shows a slight difference in the nuclear power response. This difference stems from a different treatment of power reactivity feedback in the two models. The LOFTRAN model generates power feedback as a function of core heat flux. The RETRAN model, on the other hand, uses a tabular representation for the power feedback which relates the feedback directly to neutron power. Since the reactivity feedback is more accurately a function of the fuel temperature, [ ]a,c

The [ ]a,c in the two models. Vepco's RETRAN models treat the steady state pressure error as a bias in the signal going into the proportional plus integral contoller which controls pressurizer spray and one of the two pressurizer power operated relief valves. Thus spray and one PORV are assumed to open about 30 psi below their nominal setpoints. [ ]a,c Since the spray and one PORV are actuated [ ]a,c in the RETRAN model, a [ ]a,c pressure [ ]a,c results. For safety analyses related to system overpressure and vessel integrity concerns, pressurizer PORV's and spray are assumed not to function, and this modeling [ ][a,c] on the results.

FLOW COASTDOWN

Figures V-9 to V-11 show comparisons for the flow coastdown event. Total core flow (this is a three-pump coastdown) is shown in Figure V-9. LOFTRAN uses a lumped parameter approach in solving for loop flow (the rate of change of flow is a characteristic of the entire coolant loop), whereas RETRAN solves a momentum equation at every flow junction in the loop. For incompressible flow, the two models give [ ]a,c results, as shown. Figure V-10 presents the nuclear power and core heat flux repsonse, and pressurizer presssure response for the two codes is presented in Figure V-11. The [ ]a,c following the trip is related to [ ]a,c Spray is driven by the dynamic head of the reactor coolant flowing through the loops. In the RETRAN model, under flow coastdown conditions, spray flow is assumed to be proportional to loop flow. In the LOFTRAN model, the spray flow is assumed proportional to the square of the loop flow. Thus under loss of flow conditions LOFTRAN [ ]a,c in the transient.

CONCLUSIONS

Transient results from the Vepco RETRAN models have been compared to Vepco-generated results using the LOFTRAN code. The [ ][a,c] in results is [ ][a,c] in the codes.

REFERENCE

1. Burnett, T. W. T., et al, "LOFTRAN CODE DESCRIPTION," WCAP-7907-P-A (Westinghouse Proprietary Class 2), WCAP-7907-A (Westinghouse Non-Proprietary), April 1984 .

POWER OF HEAT FLUX, FRACTION OF INITIAL

TIME, SEC.

FUEL, TEMP °F

a,c

S.G. HEAT EXTRACTION RATE
FRACTION OF INITIAL

TIME, SEC.

STEAM PRESSURE, PSIA

a,c

TAVG

TIME, SEC.

a,c

PRESSURIZER PRESSURE, PSIA.

TIME, SEC.

PRESSURIZER WATER VOLUME, $FT.^3$

STEAM PRESSURE, PSIA.

TIME, SEC.

a, c

INLET TEMP., °F

TIME, SEC.

a,c

NUCLEAR POWER ,FRACTION OF INITIAL

TIME , SEC.

a,c

PRESSURIZOR , PSIA

TIME ,SEC

a,c

1

LOOP FLOW, LB/SEC.

TIME, SEC

a,c

NORMALIZED POWER OR HEAT FLUX

TIME, SEC.

a,c

PRESSURIZER PRESSURE, PSIA.

TIME, SEC.

a,c