No: WANL-TMI-1435
Date: April 9, 1965
From: P. G. DeBaryshe
Physics & Mathematics
Subject: BOUNDARY CONDITIONS IN TDC

ASTRONUCLEAR LABORATORY

To: W. M. Jacobi (6)
D. A. McCutchan (6)
M. S. Mayer (1)
J. M. Ravets (6)
L. J. Vachon (3)
H. Woodsum (6)
Library (2)

G. H. Minton, APD (6)

MASTER

NOTICE
This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Energy Research and Development Administration, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

DISTRIBUTION OF THIS DOCUMENT UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

BOUNDARY CONDITIONS IN TDC

It is possible that occasionally the TDC code may have been used with defective reflective boundary conditions.

The boundary conditions at the ends and curved surface of the cylinder may be specified separately. For the top and curved surfaces either a free surface (zero inward flux), an approximately reflective condition, or an isotropic boundary source may be specified. For the bottom surface, either a free surface or the reflective condition may be specified.

Let $(T5)_{ig}$ be a matrix of dimension I (number of radial intervals) $\times G$ (number of groups). If a Top Boundary Source (T.B.S.) is specified, then that data is input as $(T5)_{ig}$. If a free top boundary is specified, then no core space is reserved for the $(T5)$ matrix. If a reflective top boundary condition is desired, then the matrix $(T5)_{ig}$ is calculated by the TDC code and is used in estimating boundary fluxes.

Let $N_{im}^{(-)}$ be the inwardly directed angular flux at the top of the reactor for the i^{th} radial interval, m^{th} direction, and for a given group, g . Finally, let $(S0)_i$ and $(\sigma_T)_i$ be the total source and total cross section at the i^{th} mesh interval.

INFORMATION CATEGORY

unclassified
W. D. Spawburgh 4/8/65
Authorized Classifier/Date

The input parameters AO4 and SO3 determine the top boundary conditions used:

AO4 ("T.B. Cond.")	SO3 ("T.B.S. Indic.")	Condition Applied	Effect
0	0	Free Top Boundary	$0 \rightarrow N_{im}^{(-)}$
0	1	Top Boundary Source	$(TBS)_{ig} = T5_{ig}^{input} \rightarrow N_{im}^{(-)}$
1	1	Reflective Top Boundary	$[1.0 + T5_{ig}] \frac{(SO)_i}{(\sigma_T)_i} \rightarrow N_{im}^{(-)}$
1	0	Dangerous	Dangerous

The table above shows that the parameter SO3 merely indicates whether or not core storage should be reserved for the matrix T5.

The first two options in the table are self explanatory. The third option gives an approximation to the cell condition $\left[N_{im} = \frac{(SO)_i}{(\sigma_T)_i} \right]$ implies isotropic flux return. For a reflective top boundary, $(T5)_{ig}$ is calculated from the vertical currents at the upper surface:

$$(T5)_{ig} = (T5)_{ig}^{\text{previous inner iteration}} + \frac{j_Z^{\text{out}} - j_Z^{\text{in}}}{3(j_Z^{\text{out}} + j_Z^{\text{in}})} ;$$

Of course this procedure is not perfectly accurate.

For the curved surface the same options are available. In the following table O.B.S. means Outer Boundary Source, and J is the number of vertical mesh intervals in the cylinder. Then, for a given group, g, and vertical mesh value, j, the following parameter designations determine the outer boundary conditions.

A05 ("O.B. Cond.")	S04 ("O.B. Indic.")	Condition Applied	Effect
0	0	Free Outer Boundary	$0 \rightarrow N_{jm}^{(\text{inward})}$
0	1	Outer Boundary Source	$(\text{OBS})_{j,g} = F5_{jg}^{\text{input}} \rightarrow N_{jm}^{(\text{inward})}$
1	1	"Reflective" Outer Boundary	$[1.0 + F5_{jg}] \frac{S0_{Ij}}{(\sigma_T)_{Ij}} \rightarrow N_{jm}^{(\text{inward})}$
1	0	Dangerous	Dangerous

The so called "reflective" boundary conditions in TDC are not truly reflective conditions at all, but they are reasonable cell conditions. (The boundary conditions on the Z-axis are properly handled.)

Two cautionary comments are appropriate. Firstly, the fourth option in the two tables may lead to apparently random program failure. Secondly, since truly reflective boundary conditions are not available, I recommend that, if possible, vertically symmetric core calculations be carried out using the entire core rather than a half core with a "reflective" top or bottom boundary.

 P. G. DeBaryshe