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**FINANCIAL CONSTRAINTS IN
CAPACITY PLANNING:
A NATIONAL UTILITY REGULATORY
MODEL (NUREG)**

Volume II of III:
User's Guide

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FINAL REPORT

Submitted to:
Division of Coal and Electric Power
Energy Information Administration
U.S. Department of Energy

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FINANCIAL CONSTRAINTS IN CAPACITY PLANNING:
A NATIONAL UTILITY REGULATORY MODEL (NUREG)

VOLUME II of III: USER'S GUIDE

Final Report

Submitted to:

Division of Coal and Electric Power,
Energy Information Administration
Department of Energy

by

ICF Incorporated

October 29, 1981

SUMMARY

This volume is a User's Guide to the National Utility Regulatory Model (NUREG) and its implementation of the National Coal Model. This is the second of three volumes provided by ICF under contract number DEAC-01-79EI-10579. These three volumes are:

- a manual describing the NUREG methodology,
- a users guide, and
- a description of the software.

This manual

- provides a brief introduction to the National Utility Regulation Model,
- describes the various programs that comprise the National Utility Regulatory Model,
- gives sample input files, and
- provides information needed to run the model.

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1.0 INTRODUCTION

The goal of the NUREG process is to find the 'best' capacity expansion plan for a given region. Traditionally, this has meant the least cost plan. NUREG narrows this definition to the least cost plan which is feasible in a financial sense. The first step in the process is to run the National Coal Model (NCM).^{*} The NCM produces the least cost capacity expansion plan. This plan is then run through the National Utility Financial Statement (NUFS) model. NUFS forecasts various financial parameters which indicate the financial health of the region's electric utilities. A major determinant of these parameters is the capacity expansion plan. If these parameters fall in a pre-specified acceptable range, then no further analysis is needed. If not, the NCM solution is financially infeasible and the NUREG process seeks the least-cost, financially-feasible solution. In this case, the original NCM expansion plan required larger capital expenditures than could be reasonably raised by the utilities. The goal of NUREG is to find the maximum capital outlays which the region can afford (that is, while maintaining acceptable parameter values). This maximum value is then fed back to NCM and becomes an upper bound constraint on capital expenditures. NCM is then run again with the constraint to produce the least-cost financially-feasible solution.

The approach to finding the maximum level of expenditures for each year is based on a Taylor expansion of each of the financial parameters. NCM solves for cumulative builds for the years 1985, 1990, and 1995. NUREG numerically calculates derivatives of the yearly financial parameters with respect to the cumulative value of builds for each of these years. This is done by rerunning NUFS several times. First, the costs of all builds associated with the 1985 plan are lowered by a given amount in NUFS to produce new parameters. The derivative is calculated by dividing the change in the parameter value by the percentage change in total capital costs. This is done for 1985, 1990, and 1995. Then, given these derivatives, the following constraint is imposed for each year's parameter values:

$$(1) \quad P_0 + \frac{\partial P}{\partial CA_{85}} * CA_{85} + \frac{\partial P}{\partial CA_{90}} * CA_{90} + \frac{\partial P}{\partial CA_{95}} * CA_{95} \leq \bar{P}$$

* The NUREG methodology can be used with any traditional capacity planning model. The NCM was chosen for convenience.

where:

- P_0 = parameter value from NUFS for initial NCM run,
- CA_{85} = total capital outlays (\$) through 1985,
- CA_{90} = total capital outlays (\$) through 1990,
- CA_{95} = total capital outlays (\$) through 1995,
- $\bar{P}$ = target value for parameter.

These constraints are solved simultaneously in a linear program with the objective of finding the smallest change in capital expenditures (C_{85} , C_{90} , C_{95}), which satisfies all the constraints. The solution gives the upper bounds on capital expenditures for each of the years. These values are then used to form upper bound capital expenditure constraints in the NCM. The NCM is run with these constraints to produce the least-cost, financially-feasible solution.

Volume one developed and demonstrated this methodology. The purpose of this volume is to provide a user's guide for the computer programs developed to implement the methodology. The remainder of this volume is divided into two sections. The first section introduces the various models and programs which together make up the NUREG software we have developed. The concluding section is a step-by-step guide of how to use this software.

2.0 MODELS AND INTERFACES COMPRISING NUREG

The theoretical development of NUREG found in volume one discusses the several modules necessary to implement the methodology. The two primary modules are: (1) a capacity expansion/dispatch planning module, and (ii) an electric utility finance module. The methodology is general enough to use any acceptable models to fill these modules. The purpose of this section is to briefly introduce the models chosen for these modules and also describe the remaining software needed to implement NUREG for this project. The discussion is organized as follows:

- 2.1 The Capacity Expansion/Dispatch Planning Module
- 2.2 The Finance Planning Module
- 2.3 The Capacity Expansion/Finance Interface
- 2.4 The Financial Sensitivity Program
- 2.5 The Capital Addition Adjustment Program

2.1 The Capacity Expansion Model

The traditional capacity expansion model determines capacity expansion and dispatch based on least cost for the utility or region of interest. For the purposes of this project, the National Coal Model (NCM) was chosen. The NCM solves for cumulative capital additions for each of the years 1985, 1990, and 1995. In addition, it solves for the optimal dispatch of plants for each of these years. The technique of linear programming is used for optimization.

2.2 The Finance Module

The finance module is filled by the National Utility Financial Statement (NUFS) Model, developed in the first half of this project. For the purposes of NUREG, NUFS will be used to forecast the following parameters:

- (i) interest coverage,
- (ii) AFUDC as a percent of earnings,
- (iii) actual return on equity, and
- (iv) external financing as a percentage of total applications

For inputs, NUFS requires annual capital additions and fuel costs. Because NCM solves for longer intervals, an interface between the two was developed.

2.3 The Capacity Expansion/Finance Interface

NUFS requires as inputs the forecast annual fuel costs and capacity additions. The NCM solves for these results for each 5 year interval.

Because of this problem, this interface was developed to interpolate the results of NCM and produce the annual results required by NUFS. Financial parameters for a given year are functions of future capital additions which are being constructed. To enable NUFS to forecast 1995 financial parameters, the capital additions in years past 1995 also need to be provided. To supply this need, the interface also extrapolates the trends of the 1990 and 1995 NCM solutions to produce these forecasts for the ten years following 1995. The interface uses as input the solutions from NCM and outputs the annual forecasts in a format that is read by NUFS.

2.4 The Financial Sensitivity Program (FSP)

This program is used to numerically assess the sensitivity of the financial parameters to changes in capital outlays. The outputs of this program are the partial derivatives expressing these sensitivities. FSP runs NUFS successively, each time altering the level of capacity additions. Finally, it analyzes these changes to form the derivatives. It creates a file containing the calculated derivative values which can then be read by the Capital Addition Adjustment Program.

2.5 The Capital Addition Adjustment Program (CAAP)

CAAP solves for a minimum set of capital expenditure changes from the base expansion plan that will make the region's (or utility's) financial parameters fall in a pre-specified range. This is done for each region. The linear programming package XMP is used to solve the minimization problems. The output of this program is a set of upper bounds on capital additions. This version of the program writes files that are used by the NCM revise programs to impose bounds on capital addition in 1985, 1990, and 1995. The program is quite flexible and can easily be adapted to interface with any capacity expansion model.

3.0 EXECUTING NUREG

In this section, the process of using NUREG is described in detail. A flow chart of the process for one region is shown in Figure 1. Each of the seven steps in the figure are discussed below. Detailed emphasis is given to those steps for which no other documentation exists. (The descriptions of running NCM and NUFS are brief as these models are fully documented elsewhere.) This discussion assumes the user has identified a set of NCM regions for analysis by NUREG.

3.1 Step 1 - Running NCM

The first step is to run the NCM for each of the years 1985, 1990, and 1995 for each of the regions. This initial run of NCM is to have no capital additions bounds. The solution will be that which minimizes annual costs. The outputs relevant to the NUREG process are stored in the NCM solution files and in the binary common block file known as GDATA.

3.2 Step 2 - Running the NCM/NUFS Interface

The second step is to run the NCM/NUFS Interface. This program extracts data from the NCM solution files, the NCM common block file, and the NCM historical data file, and aggregates builds, generation and fuel costs according to maps that are read by the program. These data are interpolated between NCM run years and extrapolated beyond the end of the planning horizon. NCM solution data are available for 1985, 1990 and 1995 and for the historical data for 1979. Generation, operating and maintenance (O&M) costs and fuel costs are interpolated between model run years. In addition, generation, O&M and fuel costs are interpolated between 1979 and 1985. Builds are interpolated between 1979 and 1995 on the basis of generation and are extrapolated from 1996 through 2005. The 1985, 1990, and 1995 solution files are read from units 25, 26 and 27, respectively. The common block file GDATA is read from unit 13 and the historical data file from unit 98. The solution files and GDATA file must be consistent, i.e., from the same NCM run.

The data produced by the interface are the builds and capital cost for 1979 through 2005, generation (both total and nuclear) for 1979 through 1995, operating and maintenance cost (mills/kWh), nuclear fuel cost (mills/kWh) and total fuel costs (mills/kWh) for 1979 through 1995. Figure 2 shows a sample output data set. The first group of records (up to the line with zero entries) gives the year, plant type, megawatt addition and capital cost in dollars per kilowatt for each plant type added by year. The plant type is an integer used by NUFS to identify the type of plant. The record of zeros denotes the end of this section. The next 17 records give both total and nuclear generation by year in billions of kWh. The next 17 records give the

FIGURE 1
FLOW CHART FOR NUREG PROCESS

FIGURE 2

NCM/NUFS INTERFACE FILE

1.	2	4	178.019	981.501
2.	3	4	226.245	981.501
3.	4	4	276.066	981.501
4.	5	4	327.541	981.501
5.	6	4	380.724	981.501
6.	7	4	435.679	981.501
7.	8	4	492.469	981.501
8.	9	4	854.047	1049.801
9.	10	4	937.452	1049.801
10.	11	4	1023.880	1049.801
11.	12	4	1113.435	1049.801
12.	13	4	1206.222	1049.801
13.	2	7	496.848	1325.650
14.	3	7	631.446	1325.650
15.	4	7	770.497	1325.650
16.	5	7	914.161	1325.650
17.	6	7	1062.595	1325.650
18.	7	7	1215.975	1325.650
19.	8	7	1374.473	1325.650
20.	9	7	186.276	1325.652
21.	10	7	204.467	1325.652
22.	11	7	223.318	1325.652
23.	12	7	242.851	1325.652
24.	13	7	263.088	1325.652
25.	14	7	777.735	1325.650
26.	15	7	827.225	1325.650
27.	16	7	877.353	1325.650
28.	17	7	928.127	1325.650
29.	18	7	979.561	1325.650
30.	19	7	928.284	1325.650
31.	20	7	945.792	1325.650
32.	21	7	963.676	1325.650
33.	22	7	981.795	1325.650
34.	23	7	1000.336	1325.650
35.	24	7	1019.206	1325.650
36.	25	7	1038.403	1325.650
37.	26	7	1058.025	1325.650
	.	.	.	.
	.	.	.	.
	.	.	.	.
67.	9	11	225.855	208.049
68.	10	11	247.911	208.049
69.	11	11	270.768	208.049
70.	12	11	294.450	208.049
71.	13	11	318.988	208.049
72.	0	0	0.0	0.0

FIGURE 2 (continued)

NCM/NUFS INTERFACE FILE

73.	120.383	70.157	
74.	124.658	69.944	
75.	129.085	69.731	
76.	133.669	69.518	
77.	138.416	69.304	
78.	143.331	69.091	
79.	148.421	68.878	
80.	153.546	70.190	
81.	158.848	71.501	
82.	164.333	72.813	
83.	170.007	74.125	
84.	175.877	75.437	
85.	179.194	80.579	
86.	182.573	85.721	
87.	186.017	90.863	
88.	189.525	96.005	
89.	193.100	101.147	
90.	10.855	6.000	2.242
91.	10.855	6.000	2.242
92.	10.855	6.000	2.242
93.	10.855	6.000	2.242
94.	10.855	6.000	2.242
95.	10.855	6.000	2.242
96.	10.855	6.000	2.242
97.	11.127	6.000	2.318
98.	11.405	6.000	2.395
99.	11.691	6.000	2.476
100.	11.984	6.000	2.559
101.	12.284	6.000	2.645
102.	11.970	6.000	2.693
103.	11.664	6.000	2.743
104.	11.365	6.000	2.793
105.	11.075	6.000	2.844
106.	10.792	6.000	2.897
107.	0.092	0.077	0.006

total O&M, nuclear fuel and total fuel cost, all in mills/kWh. The last record in the file contains the generation-to-sales loss factors for 1985, 1990, and 1995. This file is read by NUFS using free format.

Two maps are used by the program: a map of NCM plant types to NUFS build types and a map of NCM plant types to NUFS generation types. The build map is used to map plant types read from the names of the build vectors in the solution files to NUFS plant types. The plant initials are in the common block data. For a description of the NUFS plant types, see the NUFS documentation. The operate map is provided by the user. This consists of the plant type and the corresponding NUFS code. These maps are read from unit 5. The first record is the number of entries in the build map. It is read I2. This is followed by a record, read I2, for each build type giving the NUFS plant type. Immediately following the build map is the operate map. The first record of this section is the number of operate types read I2. Then for each operate type, there is a record containing the NCM plant type followed by the NUFS type. Each record is read A2, 2X, I2. A sample map is shown in the run stream given in Figure 3. The program writes a temporary output file for each region and one additional file for national totals (units 30, 31,...,74 as required). The next two job steps delete the old and create a new partitioned data set. Finally, utility programs (IEBGENER's) are used to copy each regional file to a member of the partitioned data set. This partitioned data set is passed to NUFS. A sample set of JCL is shown in Figure 3. Table 1 shows the units used by the interface program.

3.3 Step 3 - Running NUFS

The third step is to run NUFS using the interface files created in Step 2. For each region, NUFS will produce a short report containing the forecast values of the four financial parameters (interest coverage, AFUDC as a percentage of earnings, actual return on equity, and external financing as a percentage of total applications).

The specific instructions for running NUFS are described in the NUFS user's guide. Although the NUFS user's guide was written to describe the use of NUFS within the MEFS framework, the same instructions apply when using the NCM. A sample JCL to run NUFS for one region is shown in Figure 4. As discussed in the NUFS user's guide, five data files (FT10-FT14) and one control file (FT09) are required for input to NUFS. The user files (FT10 and FT11) contain the regulatory assumptions and other information for the privately and publicly owned utilities. An initial set of files have been set up for each NCM region under the assumption that regulatory conditions do not change over time. Of course, the analyst may wish to alter these files in order to simulate different policies (e.g., CWIP in rate base, normalization of tax savings, etc.). The historical Form 1/Form 1M files (FT12 and FT13) have been created using NUREG.FORM1.FORT and NUREG.FORM1M.FORT for each NCM region. These programs are described in Volume III of this report. The capacity expansion file (FT14) should be the file created from Step 2.

FIGURE 3

NCM/NUFS INTERFACE JCL STATEMENTS

```
1. //IS3USLUR JOB (6376,P12,,50),'SLURRY',TIME=(0,6),MSGCLASS=A
2. //GO EXEC PGM=LARGE,REGION=500K
3. //STEPLIB DD DSN=CN6376.IS3.NUREG.GOX.FINANCE,DISP=SHR
4. //GO.FT05F001 DD *
5.
6. 19
6.1 10
6.2 10
6.3 11
6.4 11
6.5 09
6.6 03
6.7 03
6.8 04
6.9 04
7. 04
7.1 03
7.2 08
7.3 06
7.4 06
7.5 06
7.6 11
7.7 11
7.8 11
7.9 07
8. 29
8.1 0 03
8.2 D 03
8.3 E 03
8.4 F 03
8.5 G 03
8.6 P 03
8.7 Q 03
8.8 R 03
8.9 V 03
9. W 03
9.1 X 03
9.2 S 03
9.3 M 03
9.4 N 03
9.5 5 03
9.6 6 03
9.7 7 03
9.8 8 03
9.9 9 03
10. H 06
10.1 I 06
10.2 Y 07
10.3 Z 07
10.4 T 09
10.5 U 09
10.6 J 08
```


FIGURE 3

NCM/NUFS INTERFACE JCL STATEMENTS (continued)

```

10.7 K 02
10.8 C 01
10.9 L 08
47. //GO.FT06F001 DD SYSOUT=A
47.1 //GO.FT07F001 DD SYSOUT=A
48. //GO.FT13F001 DD DISP=SHR,DSN=CN6143.NN1.NCM4.GDATA,LABEL=(,,IN)
49. //GO.FT25F001 DD DISP=SHR,DSN=CN6143.NN1.NCM4.A85.LPSOLN,LABEL=(,,IN)
50. //GO.FT26F001 DD DISP=SHR,DSN=CN6143.NN1.NCM4.A90.LPSOLN,LABEL=(,,IN)
51. //GO.FT27F001 DD DISP=SHR,DSN=CN6143.NN1.NCM4.A90.LPSOLN2,LABEL=(,,IN)
52. //GO.FT30F001 DD DSN=&&TEMPIL,DISP=(NEW,PASS),
53. // UNIT=SYSDA,SPACE=(TRK,(1,1)),
54. // DCB=(DSORG=PS,RECFM=FB,LRECL=80,BLKSIZE=6160)
55. //GO.FT31F001 DD DSN=&&TEMPVA,DISP=(NEW,PASS),
56. // UNIT=SYSDA,SPACE=(TRK,(1,1)),
57. // DCB=(DSORG=PS,RECFM=FB,LRECL=80,BLKSIZE=6160)
58. REPEAT FOR 44 REGIONS
59. . . .
60. . . .
61. . . .
182. //GO.FT74F001 DD DSN=&&TEMPUT,DISP=(NEW,PASS),
183. // UNIT=SYSDA,SPACE=(TRK,(1,1)),
184. // DCB=(DSORG=PS,RECFM=FB,LRECL=80,BLKSIZE=6160)
900. //GO.FT90F001 DD SYSOUT=A
1000. //GO.FT98F001 DD DSN=CN6143.NN1.NCM4.REPFIL,DISP=SHR
1001. //DELD EXEC PGM=IEFBRI4,REGION=10K
1002. //DD1 DD DSN=CN6376.IS3.NUREG.NUFSIN.DELTA,DISP=(MOD,DELETE),
1003. // UNIT=DASD,SPACE=(TRK,(10,2,2))
1004. //DELD EXEC PGM=IEFBRI4,REGION=10K
1005. //DD1 DD DSN=CN6376.IS3.NUREG.NUFSIN.DELTA,DISP=(NEW,CATLG),
1006. // UNIT=DASD,
1007. // SPACE=(TRK,(10,2,2)),DCB=(DSORG=PO,RECFM=FB,BLKSIZE=6160,LRECL=80)
1008. //GEN01 EXEC PGM=IEBGENER
1009. //SYSPRINT DD SYSOUT=A
1010. //SYSUT1 DD DISP=(OLD,DELETE),DSN=&&TEMPIL
1011. //SYSUT2 DD DISP=(OLD,KEEP),DSN=CN6376.IS3.NUREG.NUFSIN.DELTA(UIL)
1012. //SYSIN DD DUMMY
1013. //GEN02 EXEC PGM=IEBGENER
1014. //SYSPRINT DD SYSOUT=A
1015. //SYSUT1 DD DISP=(OLD,DELETE),DSN=&&TEMPVA
1016. //SYSUT2 DD DISP=(OLD,KEEP),DSN=CN6376.IS3.NUREG.NUFSIN.DELTA(UVA)
1017. //SYSIN DD DUMMY
1028. REPEAT FOR 44 REGIONS
1029. . . .
1030. . . .
1031. . . .
1238. //GEN03 EXEC PGM=IEBGENER
1239. //SYSPRINT DD SYSOUT=A
1240. //SYSUT1 DD DISP=(OLD,DELETE),DSN=&&TEMPUT
1241. //SYSUT2 DD DISP=(OLD,KEEP),DSN=CN6376.IS3.NUREG.NUFSIN.DELTA(UT)
1242. //SYSIN DD DUMMY

```

TABLE 1

NUFS/NCM	DATA FILES
<u>Unit Number</u>	<u>Data Files</u>
5	Build and Operate Maps
13	Common Block Data
25	1985 Solution File
26	1990 Solution File
27	1995 Solution File
30-74 <u>a/</u>	Temporary Output Files
98	Historical Data

a/ There is a file for each region and one for national totals.
If less than 44 regions are run, fewer units are used.

FIGURE 4

JCL FOR NUFS

```
1. //MI2UNUFS JOB (6376,D02,,15),'NUREG',TIME=(0,05)
2. //STEPRUN1 EXEC PGM=TEST,REGION=700K
3. //STEPLIB DD DSN=CN6376.MI2.NUFS.LOAD,DISP=SHR
4. //FT04F001 DD DUMMY
5. //FT06F001 DD DUMMY
6. //FT07F001 DD DUMMY
7. //FT08F001 DD SYSOUT=A
8. //FT09F001 DD *
9. * TITLE OF RUN
10. NUREG METH TEST 6/8
11. * (1)NUMBER OF YRS;(2)NUMBER OF REGIONS;(3)OPT7;(4)OPT8
12. 17 2 5 1
13. //FT10F001 DD DSN=CN6376.MI2.NUREG.PRIVATE(IL),DISP=SHR
14. // DD DSN=CN6376.MI2.NUREG.PRIVATE(VA),DISP=SHR
15. //FT11F001 DD DSN=CN6376.MI2.NUREG.PUBLIC(IL),DISP=SHR
16. // DD DSN=CN6376.MI2.NUREG.PUBLIC(VA),DISP=SHR
17. //FT12F001 DD DSN=CN6376.MI2.NUREG.FORM1.PDS78(IL),DISP=SHR
18. // DD DSN=CN6376.MI2.NUREG.FORM1.PDS78(VA),DISP=SHR
19. //FT13F001 DD DSN=CN6376.MI2.NUREG.FORM1M.PDS78(IL),DISP=SHR
20. // DD DSN=CN6376.MI2.NUREG.FORM1M.PDS78(VA),DISP=SHR
21. //GO.FT14F001 DD DSN=CN6376.IS3.NUREG.NUFSIN.BASE(U2),DISP=SHR
22. // DD DSN=CN6376.IS3.NUREG.NUFSIN.BASE(U1),DISP=SHR
23. /**
```

The control file (FT09) should be set up with Option 8=1 (i.e., standard NUFS run). The value for Option 7 can be entered as 5 if the user only desires the short report containing the financial parameters. If other detail (e.g., financial statements) is desired then other values may be entered (see NUFS user's guide). The short report is created regardless of the value of Option 7. The short report is written to unit FT08.

3.4 Step 4 - Running the Financial Sensitivity Program

At this point, the analyst must decide upon ranges of acceptable parameter values for each region. If the results for a region lie in this range, then no further work is necessary. (The least cost solution is already financially feasible.) If not, the NCM least-cost solution for the region is unacceptable and the process seeks the best financially feasible solution.

The fourth step, if necessary, is to run the Financial Sensitivity Program (FSP) for each region which had infeasible parameters. The purpose of FSP is to estimate the sensitivity of the financial parameters to changes in capital additions. These derivatives are calculated for each of the NCM build years 1985, 1990, and 1995. The program begins by successively running NUFS, each time varying the level of capital additions. Next, it examines the results and forms partial derivatives by dividing the change in the value of the parameters by the percentage change in the level of capital additions.

FSP is a set of six separate job steps. The first job step creates four different capacity expansion forecast files (for NUFS) for each region as follows. The first file is that file which was originally produced by the NCM/NUFS interface in Step 2. The second file is formed by lowering the costs of all capacity additions in the years 1979-1985 by a given percentage (the value of the percentage is a user input). Similarly, the third and fourth files are formed by lowering costs of builds for the years 1986-90, and 1991-1995, respectively. Each of the later three files correspond to the original NCM solution's capacity additions lowered in the solution years 1985, 1990, and 1995. It should be noted that the extrapolated builds for the years past 1995 are also lowered in the fourth file.

The next four job steps each run NUFS for each region using the different capacity additions files created in the first job step. Each of these job steps produces a forecast of the financial parameters corresponding to the different capacity additions files. Each of these sets of forecasts is passed to the final job step.

The final job step forms the derivatives as follows. For the 1985 derivatives, the parameter forecasts from NUFS for the 1985 reduced capacity case are subtracted from the parameter forecasts from NUFS for the original NCM solution. These differences are then divided by the percentage of capacity additions which were cut in the years 1979-1985. This yields the derivatives for the 1985 NCM solution. The 1990 and 1995 derivatives are calculated in a similar manner. These derivatives are calculated for each region, and together with other data, written to a file which will be used by the CAAP.

The program is easy to run. The JCL and the source code for FSP are all contained in one file entitled NUREG.FSP. This file is designed to be submitted as a batch job. Because of its length, a listing is not included in this volume but may be found in Volume III.

The user must provide inputs for two file units in the first job step. The first unit is FT08F001. This unit is to contain the control file. A sample control file is shown in Figure 5. The first line contains the number of regions which are infeasible (the sample is set up for 2 regions). Next, a set of inputs are entered for each of the infeasible regions. Each regional set consists of the following inputs:

<u>Line</u>	<u>Description</u>
1	Title of region (two letter code)
2	Percentage by which builds are to be reduced when calculating derivatives.
3	Two integers that define the range of years for which the derivatives are to be calculated (base year = 1). In the example, the base year is 1979, so the inputs request the derivatives to be calculated for the years 1981 through 1995.
4	Four numbers which indicate the desired bounds on each of the financial parameters. The bounds should be entered in the following order: i) the interest coverage lower bound, ii) the AFUDC as a percentage of income (entered as a percent) upper bound, iii) the actual return on equity (entered as a decimal) lower bound, and iv) the external financing as a percent of total applications (entered as a percent) upper bound.
5	Penalty weight for interest coverage for each of the years for which the derivatives are to be calculated ($W_{1,t}$ from Section 2.1.3 of Volume I).
6	Penalty weight for AFUDC as a percentage of income for each of the years for which derivatives are to be calculated. ($W_{2,t}$ from Section 2.1.3 of Volume I).
7	Penalty weight for actual return on equity for each of the years for which derivatives are to be calculated. ($W_{3,t}$ from Section 2.1.3 of Volume I).
8	Penalty weight for external financing as a percent of total applications for each of the years for which derivatives are to be calculated. ($W_{4,t}$ from Section 2.1.3 of Volume I).

FIGURE 5

SAMPLE CONTROL FILE

```

1.  2  NUMBER OF INFEASIBLE REGIONS
2.  IL *****TITLE OF FIRST INFEASIBLE REGION*****
3.  .20  PERCENTAGE REDUCTION IN BUILDS
4.  3 17  RANGE OF YEARS FOR WHICH DERIVATIVES ARE TO BE CALCULATED (1=BASE)
5.  3.0 50.0 .13 50.0  ACCEPTABLE RANGES FOR FOR INT COV,AFUDC %,ROE,EXT FIN
6.  15*100.0  PENALTY WEIGHTS FOR INTEREST COVERAGE
7.  15*100.0  PENALTY WEIGHTS FOR AFUDC PERCENTAGE OF INCOME
8.  15*100.0  PENALTY WEIGHTS FOR ACTUAL RETURN ON EQUITY
9.  15*100.0  PENALTY WEIGHTS FOR EXTERNAL FINANCING PERCENTAGE
10. VM *****TITLE OF SECOND INFEASIBLE REGION*****
11. .20  PERCENTAGE REDUCTION IN BUILDS
12. 3 17  RANGE OF YEARS FOR WHICH DERIVATIVES ARE TO BE CALCULATED (1=BASE)
13. 2.5 45.0 .14 60.0  ACCEPTABLE RANGES FOR FOR INT COV,AFUDC %,ROE,EXT FIN
14. 15*100.0  PENALTY WEIGHTS FOR INTEREST COVERAGE
15. 15*100.0  PENALTY WEIGHTS FOR AFUDC PERCENTAGE OF INCOME
16. 15*100.0  PENALTY WEIGHTS FOR ACTUAL RETURN ON EQUITY
17. 15*100.0  PENALTY WEIGHTS FOR EXTERNAL FINANCING PERCENTAGE

```

The second unit is FT10F001. This unit should contain the concatenated solution files produced by the NCM/NUFS interface in step two for each of the infeasible regions. These files should be concatenated in the same order as the regional input sets are entered in unit FT08F001.

The user must provide the NUFS input files (FT09-FT13) for each region in job steps two through five. These files will be identical to those used in step three of this methodology (running NUFS), and should be concatenated in the same order as was done for the solution files (FT10F001) in job Step 1.

There are no input files for the sixth and last job step. FSP does, however, produce two output files in this step. The first file is written to unit FT20F001. This file contains the calculated derivatives for each region and is used as an input file for CAAP. In addition to the derivatives, this file contains the number and names of the regions, the absolute level of capital expenditures, and various weights for the objective function in CAAP. The weights are those which were entered in the command file for FSP (unit FT08, job step 1). A sample of this file for two regions are shown in Figure 6. The second output file is written to unit FT21F001. This file contains the calculated elasticities instead of the derivatives. These results are for the user's benefit. They provide elasticity results which are easier to interpret than the derivatives. A sample of this file for two regions are shown in Figure 7.

FIGURE 6

SAMPLE DERIVATIVES FILE

```

1.  NUMBER OF INFEASIBLE REGIONS
2.      2
3.  TITLE OF INFEASIBLE REGION # 1
4.      IL
5.  NUMBER OF YEARS DERIVATIVES ARE CALCULATED
6.      15
7.  NUMBER OF YEARS NCM SOLVES FOR
8.      3
9.  BOUNDS FOR INT COV, AFUDC %, RT ON EQ, AND EXT FIN %
10.      3.0000    50.0000    0.1300    50.0000
11.  INT COV PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
12.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
13.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
14.      0.1000E+03
15.  AFUDC % PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
16.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
17.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
18.      0.1000E+03
19.  RT ON EQ PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
20.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
21.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
22.      0.1000E+03
23.  EXT FIN% PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
24.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
25.      0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
26.      0.1000E+03
27.  INT COV BASE CASE VALUES
28.      0.2466E+01 0.2490E+01 0.2558E+01 0.2656E+01 0.2775E+01 0.2876E+01 0.2717E+01
29.      0.2702E+01 0.2706E+01 0.2723E+01 0.2761E+01 0.2697E+01 0.2689E+01 0.2694E+01
30.      0.2729E+01
31.  AFUDC % BASE CASE VALUES
32.      0.6508E+02 0.6284E+02 0.5860E+02 0.5288E+02 0.4608E+02 0.4553E+02 0.4928E+02
33.      0.4911E+02 0.4800E+02 0.4620E+02 0.4612E+02 0.4810E+02 0.4840E+02 0.4800E+02
34.      0.4632E+02
35.  RT ON EQ BASE CASE VALUES
36.      0.1561E+00 0.1573E+00 0.1582E+00 0.1590E+00 0.1599E+00 0.1740E+00 0.1667E+00
37.      0.1672E+00 0.1672E+00 0.1671E+00 0.1741E+00 0.1705E+00 0.1704E+00 0.1700E+00
38.      0.1700E+00
39.  EXT FIN% BASE CASE VALUES
40.      0.5679E+02 0.5405E+02 0.5153E+02 0.4975E+02 0.4906E+02 0.4843E+02 0.4727E+02
41.      0.4601E+02 0.4632E+02 0.4616E+02 0.4659E+02 0.4741E+02 0.4741E+02 0.4678E+02
42.      0.4269E+02
43.  INT COV DERIVATIVES
44.      -.8530E+00 -.6850E-01 -.1998E-02 -.9440E+00
45.      -.5490E+00 -.1705E+00 -.5999E-02 -.7710E+00
46.      -.2250E+00 -.3215E+00 -.1300E-01 -.6260E+00
47.      0.1025E+00 -.5050E+00 -.2450E-01 -.5030E+00
48.      0.4400E+00 -.7140E+00 -.5350E-01 -.3980E+00
49.      0.7835E+00 -.8935E+00 -.1255E+00 -.2855E+00

```

FIGURE 6

SAMPLE DERIVATIVES FILE (continued)

50.	0.5355E+00	-.5165E+00	-.2280E+00	-.2485E+00
51.	0.4510E+00	-.2470E+00	-.3705E+00	-.2000E+00
52.	0.3760E+00	0.2400E-01	-.5315E+00	-.1575E+00
53.	0.3095E+00	0.2920E+00	-.7120E+00	-.1200E+00
54.	0.2480E+00	0.5505E+00	-.9090E+00	-.9450E-01
55.	0.3030E+00	0.3970E+00	-.7030E+00	0.4700E-01
56.	0.2210E+00	0.3265E+00	-.6175E+00	-.1550E-01
57.	0.1875E+00	0.2805E+00	-.5325E+00	-.1550E-01
58.	0.1600E+00	0.2380E+00	-.4485E+00	-.2003E-02
59.	AFUDC % DERIVATIVES			
60.	0.2790E+02	0.2350E+01	0.4997E-01	0.3080E+02
61.	0.1770E+02	0.6200E+01	0.2000E+00	0.2530E+02
62.	0.5250E+01	0.1250E+02	0.5000E+00	0.2020E+02
63.	-.8650E+01	0.2090E+02	0.9500E+00	0.1560E+02
64.	-.2395E+02	0.3120E+02	0.2200E+01	0.1160E+02
65.	-.2800E+02	0.2895E+02	0.4600E+01	0.8550E+01
66.	-.2225E+02	0.1945E+02	0.9400E+01	0.8300E+01
67.	-.1885E+02	0.8400E+01	0.1600E+02	0.7050E+01
68.	-.1565E+02	-.3650E+01	0.2410E+02	0.5950E+01
69.	-.1285E+02	-.1630E+02	0.3355E+02	0.4900E+01
70.	-.1040E+02	-.2045E+02	0.3425E+02	0.4200E+01
71.	-.1040E+02	-.1595E+02	0.2955E+02	0.2700E+01
72.	-.7950E+01	-.1335E+02	0.2615E+02	0.3650E+01
73.	-.6650E+01	-.1130E+02	0.2275E+02	0.3500E+01
74.	-.5450E+01	-.9350E+01	0.1935E+02	0.3150E+01
75.	RT ON EQ DERIVATIVES			
76.	-.9750E-02	-.8002E-03	0.0	-.1085E-01
77.	-.5750E-02	-.1700E-02	-.5007E-04	-.7950E-02
78.	-.3050E-02	-.2050E-02	-.1001E-03	-.5600E-02
79.	-.1650E-02	-.1500E-02	-.1001E-03	-.3600E-02
80.	-.7999E-03	-.4998E-03	-.3999E-03	-.1900E-02
81.	0.2725E-01	-.2125E-01	-.1700E-02	0.4400E-02
82.	0.1300E-01	-.7450E-02	-.2400E-02	0.3450E-02
83.	0.1145E-01	-.4400E-02	-.3150E-02	0.4500E-02
84.	0.1025E-01	-.2400E-02	-.3250E-02	0.5400E-02
85.	0.9250E-02	-.8500E-03	-.3100E-02	0.6200E-02
86.	0.6800E-02	0.2205E-01	-.2340E-01	0.7250E-02
87.	0.1000E-01	0.1160E-01	-.1150E-01	0.1205E-01
88.	0.5700E-02	0.8900E-02	-.9400E-02	0.7650E-02
89.	0.4850E-02	0.7900E-02	-.7300E-02	0.7250E-02
90.	0.4250E-02	0.6950E-02	-.5250E-02	0.7800E-02
91.	EXT FIN% DERIVATIVES			
92.	0.1715E+02	0.6300E+01	0.2499E+00	0.2560E+02
93.	0.2550E+01	0.1670E+02	0.6001E+00	0.2210E+02
94.	-.9850E+01	0.2635E+02	0.1050E+01	0.1835E+02
95.	-.1850E+02	0.3200E+02	0.1850E+01	0.1470E+02
96.	-.2600E+02	0.3450E+02	0.4650E+01	0.1150E+02
97.	-.2670E+02	0.2530E+02	0.1070E+02	0.8800E+01
98.	-.2330E+02	0.1030E+02	0.2110E+02	0.7700E+01
99.	-.2060E+02	-.1800E+01	0.3040E+02	0.6400E+01
100.	-.1750E+02	-.9950E+01	0.3550E+02	0.5100E+01

FIGURE 6

SAMPLE DERIVATIVES FILE (continued)

```

101.  -.1485E+02 -.1760E+02 0.4085E+02 0.3950E+01
102.  -.1250E+02 -.1905E+02 0.3815E+02 0.2400E+01
103.  -.1115E+02 -.1575E+02 0.3230E+02 0.1250E+01
104.  -.9200E+01 -.1365E+02 0.2780E+02 0.1200E+01
105.  -.7850E+01 -.1190E+02 0.2385E+02 0.7000E+00
106.  -.7050E+01 -.1085E+02 0.2085E+02 -.1000E+00
107.  TOTAL CAPITAL EXPENDITURES FOR EACH SOLUTION
108.  0.109200E+08 0.813900E+07 0.859600E+07 0.0
109.  TITLE OF INFEASIBLE REGION # 2
110.  VM
111.  NUMBER OF YEARS DERIVATIVES ARE CALCULATED
112.  15
113.  NUMBER OF YEARS NCM SOLVES FOR
114.  3
115.  BOUNDS FOR INT COV, AFUDC %, RT ON EQ, AND EXT FIN %
116.  2.5000 45.0000 0.1400 60.0000
117.  INT COV PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
118.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
119.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
120.  0.1000E+03
121.  AFUDC % PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
122.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
123.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
124.  0.1000E+03
125.  RT ON EQ PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
126.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
127.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
128.  0.1000E+03
129.  EXT FIN% PENALTY WEIGHTS FOR NOT MEETING CONSTRAINTS
130.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
131.  0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03 0.1000E+03
132.  0.1000E+03
133.  INT COV BASE CASE VALUES
134.  0.2109E+01 0.2111E+01 0.2112E+01 0.2149E+01 0.2215E+01 0.2209E+01 0.2269E+01
135.  0.2441E+01 0.2633E+01 0.2878E+01 0.3246E+01 0.3038E+01 0.2999E+01 0.2964E+01
136.  0.2939E+01
137.  AFUDC % BASE CASE VALUES
138.  0.6496E+02 0.6378E+02 0.6285E+02 0.6076E+02 0.5741E+02 0.5835E+02 0.5559E+02
139.  0.4719E+02 0.3642E+02 0.2255E+02 0.2045E+02 0.2378E+02 0.2534E+02 0.2659E+02
140.  0.2755E+02
141.  RT ON EQ BASE CASE VALUES
142.  0.1487E+00 0.1514E+00 0.1525E+00 0.1542E+00 0.1567E+00 0.1557E+00 0.1540E+00
143.  0.1571E+00 0.1587E+00 0.1590E+00 0.1905E+00 0.1755E+00 0.1744E+00 0.1742E+00
144.  0.1732E+00
145.  EXT FIN% BASE CASE VALUES
146.  0.7009E+02 0.7114E+02 0.7105E+02 0.6948E+02 0.6741E+02 0.6436E+02 0.5571E+02
147.  0.4531E+02 0.3770E+02 0.2206E+02 0.2118E+02 0.2556E+02 0.2825E+02 0.3034E+02
148.  0.3079E+02
149.  INT COV DERIVATIVES
150.  -.5245E+00 -.8850E-01 0.0 -.6350E+00
151.  -.2225E+00 -.2305E+00 0.0 -.4990E+00

```

FIGURE 7

SAMPLE ELASTICITY FILE

1.	INT COV ELASTICITIES FOR REGION # 1				
2.	-0.3459	-0.0278	-0.0008	-0.3828	0.9783
3.	-0.2205	-0.0685	-0.0024	-0.3097	0.9410
4.	-0.0880	-0.1257	-0.0051	-0.2448	0.8938
5.	0.0386	-0.1902	-0.0092	-0.1894	0.8489
6.	0.1585	-0.2573	-0.0193	-0.1434	0.8229
7.	0.2724	-0.3107	-0.0436	-0.0993	0.8248
8.	0.1971	-0.1901	-0.0839	-0.0915	0.8410
9.	0.1669	-0.0914	-0.1371	-0.0740	0.8325
10.	0.1390	0.0089	-0.1964	-0.0582	0.8349
11.	0.1137	0.1072	-0.2615	-0.0441	0.9208
12.	0.0898	0.1994	-0.3293	-0.0342	1.1693
13.	0.1124	0.1472	-0.2607	0.0174	-0.0637
14.	0.0822	0.1214	-0.2296	-0.0058	4.5169
15.	0.0696	0.1041	-0.1976	-0.0058	4.1612
16.	0.0586	0.0872	-0.1644	-0.0007	25.2191
17.	AFUDC % ELASTICITIES FOR REGION # 1				
18.	0.4287	0.0361	0.0008	0.4733	0.9838
19.	0.2817	0.0987	0.0032	0.4026	0.9526
20.	0.0896	0.2133	0.0085	0.3447	0.9035
21.	-0.1636	0.3952	0.0180	0.2950	0.8462
22.	-0.5197	0.6771	0.0477	0.2517	0.8147
23.	-0.6150	0.6358	0.1010	0.1878	0.6491
24.	-0.4515	0.3947	0.1907	0.1684	0.7952
25.	-0.3838	0.1710	0.3258	0.1436	0.7872
26.	-0.3260	-0.0760	0.5021	0.1240	0.8067
27.	-0.2781	-0.3528	0.7262	0.1061	0.8979
28.	-0.2255	-0.4434	0.7426	0.0911	0.8095
29.	-0.2162	-0.3316	0.6143	0.0561	1.1852
30.	-0.1643	-0.2758	0.5403	0.0754	1.3287
31.	-0.1385	-0.2354	0.4740	0.0729	1.3714
32.	-0.1177	-0.2019	0.4177	0.0660	1.4445
33.	RT ON EQ ELASTICITIES FOR REGION # 1				
34.	-0.0625	-0.0051	0.0	-0.0695	0.9724
35.	-0.0366	-0.0108	-0.0003	-0.0505	0.9434
36.	-0.0193	-0.0130	-0.0006	-0.0354	0.9286
37.	-0.0104	-0.0094	-0.0006	-0.0226	0.9029
38.	-0.0050	-0.0031	-0.0025	-0.0119	0.8946
39.	0.1566	-0.1221	-0.0098	0.0253	0.9773
40.	0.0780	-0.0447	-0.0144	0.0207	0.9131
41.	0.0685	-0.0263	-0.0188	0.0269	0.8666
42.	0.0613	-0.0144	-0.0194	0.0323	0.8519
43.	0.0554	-0.0051	-0.0186	0.0371	0.8548
44.	0.0391	0.1266	-0.1344	0.0416	0.7517
45.	0.0586	0.0680	-0.0674	0.0707	0.8382
46.	0.0335	0.0522	-0.0552	0.0449	0.6798
47.	0.0285	0.0465	-0.0429	0.0426	0.7517
48.	0.0250	0.0409	-0.0309	0.0459	0.7628

FIGURE 7

SAMPLE ELASTICITY FILE (continued)

49.	EXT FIN% ELASTICITIES FOR REGION # 1				
50.	0.3020	0.1109	0.0044	0.4508	0.9258
51.	0.0472	0.3090	0.0111	0.4089	0.8982
52.	-0.1912	0.5114	0.0204	0.3561	0.9564
53.	-0.3719	0.6432	0.0372	0.2955	1.0442
54.	-0.5410	0.7179	0.0968	0.2393	1.1435
55.	-0.5513	0.5224	0.2209	0.1817	1.0568
56.	-0.4929	0.2179	0.4464	0.1629	1.0519
57.	-0.4477	-0.0391	0.6607	0.1391	1.2500
58.	-0.3778	-0.2148	0.7664	0.1101	1.5784
59.	-0.3217	-0.3813	0.8850	0.0856	2.1266
60.	-0.2683	-0.4089	0.8188	0.0515	2.7500
61.	-0.2352	-0.3322	0.6813	0.0264	4.3201
62.	-0.1941	-0.2879	0.5864	0.0253	4.1249
63.	-0.1678	-0.2544	0.5098	0.0150	5.8571
64.	-0.1651	-0.2542	0.4884	-0.0023	-29.4934
65.	INT COV ELASTICITIES FOR REGION # 2				
66.	-0.2487	-0.0420	0.0	-0.3011	0.9654
67.	-0.1054	-0.1092	0.0	-0.2364	0.9078
68.	0.0374	-0.1955	0.0	-0.1858	0.8510
69.	0.1519	-0.2717	0.0	-0.1426	0.8401
70.	0.2474	-0.3442	-0.0014	-0.1079	0.9100
71.	0.3353	-0.3991	-0.0091	-0.0647	1.1259
72.	0.2045	-0.2294	-0.0295	-0.0480	1.1331
73.	0.1442	-0.1114	-0.0610	-0.0262	1.0782
74.	0.1001	-0.0104	-0.0949	-0.0078	0.6827
75.	0.0804	0.0952	-0.1384	0.0250	1.4861
76.	0.0373	0.1807	-0.1984	0.0168	1.1652
77.	0.0486	0.1333	-0.1718	0.0089	1.1296
78.	0.0475	0.1291	-0.1686	0.0107	0.7501
79.	0.0455	0.1228	-0.1628	0.0121	0.4533
80.	0.0432	0.1148	-0.1531	0.0145	0.3410
81.	AFUDC % ELASTICITIES FOR REGION # 2				
82.	0.3471	0.0446	0.0	0.4010	0.9770
83.	0.1654	0.1301	0.0	0.3191	0.9263
84.	-0.0509	0.2705	0.0	0.2554	0.8598
85.	-0.2666	0.4337	0.0	0.2033	0.8219
86.	-0.4921	0.6349	0.0017	0.1637	0.8830
87.	-0.5578	0.6298	0.0111	0.1088	0.7638
88.	-0.3895	0.4353	0.0450	0.0899	1.0100
89.	-0.3263	0.2628	0.1324	0.0699	0.9848
90.	-0.2828	0.0014	0.3144	0.0508	0.6486
91.	-0.2683	-0.6497	0.8647	0.0177	-2.9996
92.	-0.1858	-0.7311	0.8826	0.0440	-0.7779
93.	-0.1808	-0.5887	0.7843	0.0505	0.2916
94.	-0.1638	-0.5308	0.7202	0.0434	0.5909
95.	-0.1429	-0.4701	0.6581	0.0451	1.0000
96.	-0.1270	-0.4192	0.5971	0.0399	1.2728
97.	RT ON EQ ELASTICITIES FOR REGION # 2				
98.	-0.0555	-0.0007	0.0	-0.0572	0.9823
	.	.	.	.	.
	.	.	.	.	.
	.	.	.	.	.

3.5 Step 5: Running the Capital Addition Adjustment Program

The fifth step is to run the Capital Addition Adjustment Program (CAAP). A sample JCL file is shown in Figure 8. CAAP finds a set of capital bounds for each NCM region specified in the file provided by FSP. This file is read from unit 20. The data read by CAAP are, for each region:

- actual financial parameters from an unconstrained NCM run,
- target financial parameters,
- weights by year and parameter that are applied to financial parameters that cannot be met, and
- the derivatives of the financial parameters with respect to capital additions.

The linear programming package XMP is used to perform the optimization. The two output files are called TEST.REV85.INDATACB and TEST.REVISE.INDATACB. These files are read by NCM's revise programs. The first file is used by the 1985 revise program and is written to unit 85. The second file is used by the 1990/1995 revise program. To assemble this file, it is necessary to write 1990 and 1995 tables to temporary files (units 90 and 95) and assemble these tables in separate job steps (called "CONCAT" in this sample). Figures 9 and 10 show samples of these two files. The format of each table is:

- a record containing the number of records in the table and the year read I2, I3X, I2, and
- records containing the region name followed by the cumulative upper bound on capital additions in millions of dollars, read 9X, A2, 6X, F10.3.

3.6 Step 6 - Re-Running NCM

Rerun NCM after revising the matrices using REV85CA.INDATA and REVISECB.INDATA.

3.7 Step 7 - Re-Running NUFS

Rerun NUFS to verify the values of the financial parameters.

FIGURE 8
CAAP JCL STATEMENTS

```
1. //IS3UCON JOB (6376,M20),'SHAVEL',TIME=(,6)
2. //FORT EXEC FORTXCLG,PARM,FORT='OPT=2',REGION=1000K
3. //FORT.SYSPRINT DD SYSOUT=A
4. //FORT.SYSIN DD DSN=CN6376.IS3.NUREG.NN1.CAAP.FORT,DISP=SHR
5. //LKED.SYSLIN DD DSN=&LOADSET,DISP=(OLD,DELETE)
6.     INCLUDE SUBS(GO)
7. //LKED.SUBS DD DSN=CN6376.IS3.XMP.GOX,DISP=SHR
8. //GO.FT05F001 DD DSN=CN6376.IS3.NUREG.MATRIX,DISP=(OLD,KEEP),
9. //   DCB=(BLKSIZE=6160,LRECL=80,RECFM=FB),
10. //   SPACE=(TRK,(30,1),RLSE),UNIT=3350
11. //GO.FT06F001 DD SYSOUT=A
12. //GO.FT10F001 DD SYSOUT=A
13. //GO.FT20F001 DD DSN=CN6376.MI2.NUREG.TEST,DISP=SHR,
14. //   LABEL=(,,,IN)
15. //GO.FT40F001 DD SYSOUT=A
16. //GO.FT50F001 DD SYSOUT=A
17. //GO.FT95F001 DD DSN=CN6376.IS3.NUREG.TEST.REV85.INDATACB,
18. //   DISP=(OLD,KEEP)
19. //GO.FT90F001 DD DSN=&&REV1,DISP=(NEW,PASS),UNIT=SYSDA,
20. //   SPACE=(TRK,(3,1),RLSE),DCB=(LRECL=80,BLKSIZE=6160,RECFM=FB)
21. //GO.FT91F001 DD DSN=&&REV2,DISP=(NEW,PASS),UNIT=SYSDA,
22. //   SPACE=(TRK,(3,1),RLSE),DCB=(LRECL=80,BLKSIZE=6160,RECFM=FB)
23. //GO.FT99F001 DD DSN=CN6376.IS3.NUREG.TEST.MASTER,DISP=SHR
24. /*
25. //CONCAT EXEC PGM=IEBGENER
26. //SYSPRINT DD SYSOUT=A
27. //SYSUT1 DD DSN=&&REV1,UNIT=SYSDA,DISP=(OLD,DELETE)
28. //SYSUT2 DD DSN=CN6376.IS3.NUREG.TEST.REVISE.INDATACB,
29. //   DISP=(OLD,KEEP)
30. //SYSIN DD DUMMY
31. /*
32. //CONCAT EXEC PGM=IEBGENER
33. //SYSPRINT DD SYSOUT=A
34. //SYSUT1 DD DSN=&&REV2,UNIT=SYSDA,DISP=(OLD,DELETE)
35. //SYSUT2 DD DSN=CN6376.IS3.NUREG.TEST.REVISE.INDATACB,
36. //   DISP=(MOD,KEEP)
37. //SYSIN DD DUMMY
```

FIGURE 9
SAMPLE 1985 REVISE FILE

1.	0201TABLE CAPBD	
2.	*	CPBD85
3.	VM	99999.
4.	IL	99999.

FIGURE 10

SAMPLE 1990/1995 REVISE FILE

1.	0201TABLE CAPBD90	
2.	*	CPBD90
3.	VM	99999.
4.	IL	99999.
5.	0201TABLE CAPBD95	
6.	*	CPBD95
7.	VM	99999.
8.	IL	99999.