UM-6

PREPARATION OF WORKING TABLE

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ABSTRACT

A computer model is presented for quantifying the impacts of multipurpose water management policy. The model is designated for analysis of water availabilities throughout a river basin over extended time periods. It is capable of simulating ten daily storage,flow and diversion of water in a complex river basin system.

The model PISIM-I is synthesized from previosuly existing models. An advantage of this model is its optimizing capability with respect to reservoir opeating rules. Also PISIM-I is able to simulate institutional dictates governing water allocation,such as water rights priorities. For the first time, reservoir factor is introduced to the reservoir operation model.

1.0 INTRODUCTION

It is often necessary for water resources planners and designers to have some tools to analyse alternate management strategies and to choose the best possible solution for computer problems which is difficult to deal within a reasonable time schedule. The tools such as computer models and data management systems, provide the means to test the impact of various water resource policies/rules with reasonable accuracy before they are actually applied to the specified systems. A computer model designated as PISM-I that simulates the behaviour of a river basin system is presented here.

1.1 Purpose and Capabilities

A computer model is selected and modified from the existing ones to analyse the impact of alternate working rules and to identify the best, amongst them. The model described herein is capable of analysing systems of any configuration, given the specified policy, flow constraints of distribution components and demand. The level of demand satisfaction depends on the storage availability at any instant of time in the respective reservoirs from where individual users have the right to draw their share. But, identification of the reservoir from which the releases are to be made for meeting the demands and quantity of water that should be stored depends upon the user assigned working rules. Even though the model is capable of allocating water to meet the demands for power, irrigation water supply is considered to be primary.

1.2 Terminology

a) Operation rule

Operation rule is defined as the amount of water that is expected in each reservoir at the end of time period and their inter-related priorities in comparison with the requirements of various demand points of the river basin system.

b) Hydrologic state

The storage position of the reservoir/system is known as the hydrologic state. The following three types of states are considered in the model i) dry state ii) average state iii) wet state. They are differentiated by user assigned fractions of reservoir/system storage.

c) Unit reservoir factor (R.F.)

It is the ratio of the available storage and the indent. Reservoir factor is used to make proportional reduction in releases whenever storage goes down below the normal position. This is worked out from the available inflow and indent.

d) Unit reservoir factor storage

The storage that may be expected in any normal year after meeting the ident is known as the unit reservoir factor storage i.e. the storage corresponding to unit reservoir factor which is the balance storage for any time period under consideration (10 daily, monthly or weekly). The balance storage is computed as the difference between the cumulative inflow and cumulative indent.

The cumulative available flow may be calculated as follows:

i) Calculate the average of ten daily flows from the available records.

ii) Calculate the average losses or gains between the point of release and the point where a desired indent is required.

iii) Calculate the estimated evaporation losses from the reservoir. The evaporation is a function of water spread area and the evaporation rate during that time. As such it is necessary to find out the average or probable elevation during each period of the year. Thus it may not be possible to estimate the average evaporation loss in volume unless it is operated for the entire simulation period. Hence it is required to update this loss after a preliminary run (iteration) has been made.

iv) Substract/add the above two items of losses/gains from the available average flows

v) Convert this available average flow into volume unit for each period and find out successive totals starting from end of the water year (May 31st) and working backwards. This is the cumulative available flow. Similarly cumulative indent on any reservoir may be worked out. The balance storage that remains at the reservoir at the end of each period is known as the Unit reservoir Factor Storage of the ten daily periods.

e) Nodes

Reservoirs and non-storage junctions are represented by nodes.

f) Links

River reaches and canals are represented by links.

g) Arc

Link that connects any type of nodes is termed as arc.

1.3 Scope

The objective of this study is to provide the water resource Engineers, who are engaged in multi reservoir operation study both in the pre and post reservoir storages with a comprehensive and useful tool for evaluating the impacts of alternate water management policies on water availabilities at various critical points in a river basin. Depending upon the availability and demands, import/export on a seasonal basis can be determined.

1.4 Hardware and Software

Using VAX-11/780 computer system and VAX/VMS version 3.2 operating system the programme takes 26 seconds of CPU time to compile. The source file occupies a disk storage of 75 blocks. For the hypothetical problem shown here it requires 11 seconds of CPU time to execute the 2 years of simulation.

2.0 METHODOLOGY AND FORMULATION

The computer model employs the 'Out-of-Kilter Algorithm' to minimize the total cost of flows in a network of interconnected reservoirs, river reaches and canals. It diverts and stores water according to the user-assigned priorities or cost functions. Using the local optimum, the system is simulated for the period for which inflow and evaporation data are available.

The general structure of Out-of-Kilter Algorithm used in Texas Water Development Board River Basin model SIMYLD is maintained in the present model. The physical water resources systems are represented as a capacitated flow networks. Reservoirs demand points and canal diversion are represented as nodes while river reaches and canal connecting node to node linkages. In order to consider demands, inflows, operating rules along with the physical system link arcs, initial storage and inflow arcs, end of ten-daily desired storage arcs, balance of final storage and maximum reservoir capacity arcs, demand arcs, spill arcs and net balance arcs are included.

The assumptions made in the model are :

1) All storage nodes and linkages must be bounded from above and below.
2) Linkages must be unidirectional.

3) Any reservoir in the system can be designated as a spill node for losses from the system even though, spillage is the most expensive alternate.

4) Reservoir Operation Policies are provided by the user as desired in storage volume for each reservoir at the end of each ten daily period throughout the simulation.

5) The level of demand satisfaction is a function of water availability at the beginning of the current time period, water that may be expected during the rest of the period on a mean year basis and the indent during the rest of the period of the year to the controlling reservoir.

6) Power production is secondary. It is a function of installed capacity as well as the requirement of water releases for other purposes like irrigation,drinking water supply etc.

7) Water levels for the purpose of power computation and for evaporation determination are considered on the average basis during the ten daily period.

2.1 Mathematical Formulation

With the given set of constraints (boundaries) of mass balance through the network and cost (priority ranks) of flow through various links, the model sequentially solve the following linear optimization problem through the Out-of-Kilter Algorithm.

The objective function is

$$\text{Minimize} \sum_{i=1}^{N} \sum_{j=1}^{N} W_i \quad q_{ij}$$

subject to:

$$\sum_{i=1}^{N} q_{i,j} - \sum_{i=1}^{N} q_{ji} = 0 \quad j = 1,.....N$$

$$l_{ij} \leq q_{ij} \leq u_{ij} \quad \text{for } i,j=1,.......N$$

$$l_{ij} \geq 0$$

where,

q_{ij} = flow from node i to node j

w_{ij} = weighting or priority factor per unit of flow for node i to node j

l_{ij} = lower bound on flow in the linkage connecting node i to node j

u_{ij} = upper bound on flow in the linkage connecting node i to node j

The'Out-of-Kilter Algorithm'is an extremely efficient Primal- dual simplex algorithm that takes advantage of the special structure of network, type problem. It is published by Fulharson,D.R. and Widly (1961). It is commonly used in the network problems. PISIM-I is developed at the institute using the version of TWDB's model SIMYLD. The flow chart for the model is given in figure 1. It computes the hydrological status on a ten daily basis by considering current reservoir storage levels and expected mean flow to the reservoirs. Expected mean flow (computed from historical flow record)

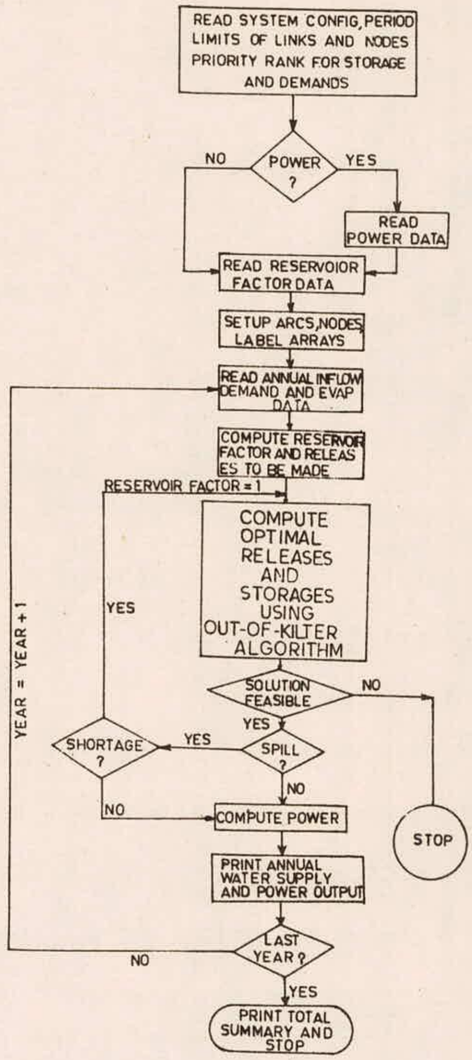

FIG. -FLOW CHART OF PISIM-I

includes the flow into the reservoirs and the loss/gain between the controlling reservoir and its demand points. Flow occuring at down stream is also assumed as flow into the reservoir for the hydrological states (average, dry, wet) computation. All or some of the reservoirs within the system are used for the determination of hydrological state by performing the following analysis.

$$R = \sum_{i=1}^{N} S_{it} + \sum_{i=1}^{N} I_{i}, t+1$$

where,

$$W = \sum_{i=1}^{N} (SU_{1}, t+1)$$

N = number of reservoirs in the system

t = current time period

$S_{i,t}$ = end of period t storage in reservoir 1

$SU_{i,t+1}$ = Unit reservoir capacity, for the reservoir i and time period t+1

$I_{i,\ t+1}$ = Inflow during the period t+1

The programme uses different maximum reservoir levels with respect to the time period and the volume that exceeds these levels will not be available for the next time period.

The user specifies the upper and lower bounds of the average state as fractions of the total sub system unit storage capacity of each time period.

$LB = X_1\ W$

$UB = X_2\ W$

where,

LB = Lower bound of average state

UB = Upper bound of average state

X_1 = Percentage which defines lower limit of average state

X_2 = Percentage which defines upper limit of average state

Subsequently, the hydrologic states are defined as :

Dry : $R < LB$

Average : $LB \leq R \leq UB$

Wet : $R \geq UB$

For the above method of calculating target operating rules for a long period of analysis, three target storage levels are used. Associated with each one of these hydrologic states there is a corresponding set of operating rules and ranking priorities (costs) for meeting the demands at various nodes and maintaining the desired storage.

The level of demand satisfaction of any node is a function of the storage position of its controlling reservoir. In order to work out the proportional reduction in supply corresponding to the controlling reservoir storage. The reservoir factor is used here.

Reservoir factor is worked out as shown below :

$$R.F. = \frac{S_t + F_{t'}}{I_{t'}}$$

S_t = last month end (this month beginning) storage I_t.

$F_{t'}$ = cumulative inflow during the remaining period of the year including the loss or gain between the controlling reservoir and the demand point and on the reservoir.

$I_{t'}$ = Cumulative indent on the reservoir during the remaining period of the year.

For this purpose, the inflow during the rest of the period (either the meanflow or dependable flow depending upon the basin character) may be used.

In India most of the river basins assume June to September as the filling in period and required (Planned) rleases are made irrespective of the storage position in the reservoir. Because of this fact the reservoir factor is pre-set in the computer programme as unity between June to September.

During planning stage computation is based on the conventional formula using head, discharge, and efficiency of turbine
to be selected. Whereas systems under operations have been 5
calibrated and tables of power production are prepared (head
versus discharge). This avoids selection and scheduling of
turbines of different capacities working under different heads; 6
also power interpretation from this table is more accurate.
Therefore, these two options are provided in this model so that
it can be used by water resources planners for both pre and 7
post reservoir conditions.

PISIM-1 does not evaluate the optimal working rule but
given a working rule it simulates the system and prints out the 8
details required by the planner/designer to analyse specific issues. Experience and knowledge of the problem will determine the users' policy.

2.2 Data Requirement

The data requirement of the model is as follows :

The junctions or nodes of the reservoir system shall be described by name and number. A node may be a storage reservoir or a diversion point without any storage. (The diversion point also will be considered as a reservoir but with zero storage). For the computational efficiency, reservoirs with storage are to be numbered first. Their minimum and maximum storages must be supplied as input data. Similarly it is necessary to furnish the maximum and minimum carrying capacities of river and canal reaches (links). The maximum capacities of river reaches shall be in such a way that it would be able to carry the spill from the upstream reservoirs/control points and the reach inflows. The minimum capacities may be zero unless low flow augmentation for fissi-culture or navigation are practiced. Should the maximum and minimum boundary conditions of nodes and links are violated due to insufficient and excess flow,infeasible solution will result during the optimization process by Out-of-Kilter Algorithm. The minimum storage may be the dead storage that has to be maintained considering power and low-flow augmentation. The maximum storage will change with time unless the reservoir is over designed. Any of the reservoirs may be designated as spill reservoirs. But it is better to designate the last reservoir to analyse the seasonal loss from the system unless serious problems arised in the carrying capacity of the upstream rivers or canals. The area-capacity elevation tables a re provided for power and evaporation loss computations.

Operation rules are provided as the relative priority ranks of meeting the demands and desirable storage levels of various nodes to decide the optimal release for the time period under consideration. Since the optimization technique used here is a minimization one, lower the rank number higher will be the priority assumed. Thus the rule used in this simulation is based on ten daily operating criteria in terms of the unit reservoir storage that is desired to be in the reservoir at the end of each period for each of the dry,wet and average states.

Two options are provided for the power computation. If power computation has to be performed on the basis of conventional method as it happens during planning stage discharge versus tail water elevation table and head versus efficiency are required to be given as input. If power production calibration is done on the turbine (which is generally done for systems under operation) head-discharge-power table may be given. Thus for any head versus discharge, a double interpolation is made to pick up the power generated.

The expected cumulative inflow as per mean year or dependent year and indent during the rest of the year (in volume unit) are to be furnished. The mean or dependent year's(in terms of ten daily distribution inflow and the unit reservoir factor storage are also to be provided for each reservoir subsequently.

The inflow and demand (unit reservoir factor demand) data for all the junctions for the entire simulation period shall be given as input,node by node.

Demand data given here should be the maximum requirement for the period at the intake points. This data may be in any units but conversion factor has to be fed to convert this flow data into the storage (volume) unit. Evaporation rate during the simulation period has to be given for the storage nodes in the ascending order. The unit should be in such a way that evaporation rate multiplied by area given in the elevation capacity table should yield in capacity/storage (volume unit).

2.3 Analysis

PISIM-I simulates the system with a set of operation policies in terms of desired storage and demand priority. To differentiate the dry,average and wet conditions the unit reservoir factor storage is used. The normal practice adopted to demarcate different zones (dry,wet and average hydrological states) are invariably assigned to arbitrary fraction of the total capacity of the reservoir (system of reservoirs) to the entire year irrespective of the time period under consideration But, in this model, the status is identified through unit reservoir factor storage of each time period.

The actual maximum storage adopted for a particular season depends upon the user assigned variable maximum storage capacity. Since, most of the reservoirs are constructed for conservation requirements as well. During the high flow periods flood regulation is also considered for the safety of the down stream control points as well as for the safety of the dam itself.

The upper bound of the demand arc is the demand prescribed by the user, provided the reservoir factor in unity. Otherwise this value is computed by finding out the controlling reservoir factor (R.F.) and multiplying it by the user prescribed demand. But,wherever surplus waters are available at the downstream of the reservoir, which could be diverted to meet the maximum demand of the season the upper bound of the demand are relaxed to meet the user prescribed maximum demand rather than allowing it to spill from the system.

Since the time lag for routing the flow is not considered and the average flow for the period is adopted, the selection of the time period should be as small as practicable. Keeping in view, the cost of computation a ten daily schedule is adopted.

2.4 Advantages and Limitations

The model is capable of simulating the water storage, transport and distribution morphology of a river basin system to a very high level of resolution. The reservoir factor that is an important criteria to decide on the level of demand satisfaction is included for the first time in the river basin management model to monitor any likely critical period. The use of variable maximum levels avoids the possibility of over estimation of yield.

Another feature of this model is its quasi-optimizing capability which enables it to include, very satisfactorily the quantifiable aspects of institutional structures governing stream diversion, water storage and exchange. This will facilitate to incorporate any changes caused due to the inclusion of any future developmental activity in the system.

The power option provided by the model, facilitates the quantification of power production both in the planning stage and operational stage. Two types of option viz., conventional method and interpolation method for power computation are provided.

However, the model gives priority for the water releases from the reservoirs for the irrigation requirements over the power demand.

2.5 Appendices

2.5.1 Computer Programme

```
C       RIVER BASIN SIMULATION COMPUTER PROGRAM
C       FOR IRRIGATION AND POWER OPERATION
C       IRRIGATION RELEASES ARE BASED ON RESERVOIR FACTOR
C       NATIONAL INSTITUE OF HYDROLOGY ROORKEE
        COMMON/CONTRL/KIN,KOUT,KAPE1,KAPE2,KAPE3,KPNCH
        OPEN(UNIT=1,RECORD SIZE=120,STATUS='OLD',FILE='10D.DAT')
        OPEN(UNIT=20,FILE='NN.BIN',FORM='UNFORMATTED',STATUS='NEW')
        OPEN(UNIT=3,RECORD SIZE=132,STATUS='NEW',FILE='OUT.DAT')
        READ(1,11) KIN,KOUT,KAPE1
  11    FORMAT(10X,8I5)
        CALL CARDS
        CALL OUT1
         CALL DATA1
        CALL SETNET
        CALL OPRATE
        CALL OUT3
        CLOSE(UNIT=1)
        CLOSE(UNIT=20)
        STOP
        END
```

```
        SUBROUTINE DATA1
        INTEGER RCAP,RMIN,FSTART,RLAD,RLON,ACTAB,DEM,DEMR,OPRP,SP,
        1CMAX,CMIN,START,UREG
        COMMON/CONTRL/KIN,KOUT,KAPE1
        COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
        1NR
        COMMON/WRKD/START(20),STEND(20),USE(20),UREG(20),ISHTM(20,36),
        1ISPIL(20,36),AREAX(20),EVPT(20),AMAX(20),AMIN(20),IAREA(20)
        COMMON/PRNT/ICAP(20,36,13),TOTLS(20,20,36)
        COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
        1,NPRES(20),ACTAB(20,20,2),OPRR(3,20,36),OPRP(3,10),SP(20),DEM
        2(20),DEMR(20,3),DEMD(20,36),EVAP(20,36),U(20,36),DIMP(36),IMPRT,
        3ARF(15,36),AREG(36),RVCAP(20,36),MWP(20)
        COMMON/LINK/LNODE(200,2),CMAX(200),CMIN(200)
        COMMON/CONFAC/AVRGLO,AVRGHI,CONFLO,CONDEM,CONINF,CPCT,NSRS,
        1LRULE,JESVOL(20)
        COMMON/RFAC/NODMP(15),NADMP(15,15),EXOUT(15,36),FAC(15,36),IAVEP
        1(15,37),NRF,EXINF(15,36),ST(15,36)
        COMMON/DEMON/DEMON(20,36)
        DIMENSION IVOL(20)
        DIMENSION W(20,20,36),D(20,20,36),E(20,20,36)
        EQUIVALENCE(W(1,1,1),ICAP(1,1,1))
        REWIND KAPE1
        READ(KIN,11)(((W(I,J,K),K=1,36),I=1,NYEAR),J=1,NJ),
```

```
      1(((D(I,J,K),K=1,36),I=1,NYEAR),J=1,NJ)
      READ(KIN,12) (((E(I,J,K),K=1,36),I=1,NYEAR),J=1,NRES)
12    FORMAT(12F8.3)
11    FORMAT(12F8.0)
      DO 5 IY=1,NYEAR
      WRITE(KAPE1) ((W(IY,J,K),K=1,36),J=1,NJ),((D(IY,J,K),K=1,36),
      1J=1,NJ),((E(IY,J,K),K=1,36),J=1,NRES)
C     YPE  11, ((W(IY,J,K),K=1,36),J=1,NJ),((D(IY,J,K),K=1,36),
C     J=1,NJ),((E(IY,J,K),K=1,36),J=1,NRES)
5     CONTINUE
      REWIND KAPE1
      RETURN
      ENTRY DATA2
      READ(KAPE1)((U(J,K),K=1,36),J=1,NJ),((DEMON(J,K),K=1,36),
      1J=1,NJ),((EVAP(J,K),K=1,36),J=1,NRES)
199   CONTINUE
      DO 6 J=1,NJ
      DO 6 K=1,36
      U(J,K)=U(J,K)*CONINF
      DEMON(J,K)=DEMON(J,K)*CONDEM
6     CONTINUE
      RETURN
      ENTRY RULE(MON)
      TSUBMX=0.0
      WTRSYS=0.0
      IF(NRES.EQ.0) GO TO 10
      DO 8 JN=1,NRES
      IVOL(JN)=0
      DO 7 KN=1,NSRS
7     IF(JN.EQ.JESVOL(KN)) IVOL(JN)=1
      TSUBMX=TSUBMX+ST(JN,MON)*IVOL(JN)
      ITEMP=START(JN)+AREG(JN)
      TEMP=FLOAT(ITEMP)
      WTRSYS=WTRSYS+TEMP*IVOL(JN)
8     CONTINUE
10    CONTINUE
      LRULE=1
      XMAX=TSUBMX*AVRGHI
      XMIN=TSUBMX*AVRGLO
      IF(WTRSYS.LT.XMIN)LRULE=2
      IF(WTRSYS.GT.XMAX) LRULE=3
      IF(AVRGLO.LE.0.0) LRULE=1
      IF(AVRGHI.LE.0.0)LRULE=1
      RETURN
      END


      SUBROUTINE AREA(X,Y)
```

```
      INTEGER RCAP,RMIN,FSTART,RLAD,RLON,ACTAB,DEM,DEMR,OPRP,SP
      COMMON /CONTRL/KIN,KOUT,KAPE1
      COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
     1NR
      COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
     1,NPRES(20),ACTAB(20,20,2),OPRR(3,20,36),OPRP(3,10),SP(20),DEM
     2(20),DEMR(20,3),DEMD(20,36),EVAP(20,36),U(20,36),DIMP(36),IMPRT,
     3ARF(15,36),AREG(36),RVCAP(20,36),MWP(20)
      COMMON/WRKD/START(20),STEND(20),USE(20),UREG(20),ISHTM(20,36),
     1ISPIL(20,36),AREAX(20),EVPT(20),AMAX(20),AMIN(20),IAREA(20)
      INTEGER X(20),Y(20)
      IF(NRES.EQ.0) GO TO 11
      DO 10 J=1,NRES
      DO 5 I=1,18
      IF(X(J)-ACTAB(J,I,2)) 2,3,5
5     CONTINUE
      Y(J)=AMAX(J)
      GO TO 10
3     Y(J)=ACTAB(J,I,1)
      GO TO 10
2     X1=ACTAB(J,I,2)-ACTAB(J,I-1,2)
      Y1=ACTAB(J,I,1)-ACTAB(J,I-1,1)
      X2=X(J)-ACTAB(J,I-1,2)
      X3=(X2/X1)*Y1
      Y(J)=ACTAB(J,I-1,1)+IFIX(X3)
10    CONTINUE
11    CONTINUE
      RETURN
      END


      SUBROUTINE OUT1
      INTEGER RCAP,RMIN,FSTART,RLAD,RLON,ACTAB,DEM,DEMR,OPRP,SP,
     1CMAX,CMIN
      COMMON /CONTRL/KIN,KOUT,KAPE1
      COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
     1NR
      COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
     1,NPRES(20),ACTAB(20,20,2),OPRR(3,20,36),OPRP(3,10),SP(20),DEM
     2(20),DEMR(20,3),DEMD(20,36),EVAP(20,36),U(20,36),DIMP(36),IMPRT,
     3ARF(15,36),AREG(36),RVCAP(20,36),MWP(20)
      COMMON/LINK/LNODE(200,2),CMAX(200),CMIN(200)
      COMMON/CONFAC/AVRGLO,AVRGHI,CONFLO,CONDEM,CONINF,
     1CPCT,NSRS,LRULE,JESVOL(20)
      COMMON/POW/ NROW(5),NCOL(5),F(5,25,25),EATAB(5,18,2),TWTAB(5,18,2),
     1PLTAB(5,18,2),
     1HNET(36,5),FDIS(36,5),CELE(36,5),CTWL(36,5),ROW(5,25),
     1COL(5,25),AREA(36,5),HYDL(20)
      COMMON/RFAC/NODMP(15),NADMP(15,15),EXOUT(15,36),FAC(15,36),IAVEP(15,37)
```

```
      1,NRF,EXINF(15,36),ST(15,36)
      DIMENSION COND(3)
      DATA COND/4HAVRG,4HDRY ,4HWET /
      WRITE(KOUT,11) TITLE
11    FORMAT(///////25X,'RIVER BASIN SIMULATION PROGRAM
      1      *** NATIONAL INSTITUE OF HYDROLOGY ***'//25X,20A4)
      WRITE(KOUT,13)NJ,NRES,NL,NR,IYEAR,NYEAR,
      1ND,NS,NRF,IMP
13    FORMAT(//25X,'NUMBER OF NODES =',I5
      1,14X,'NUMBER OF RESERVOIRS =',I3//25X,'NUMBER OF
      1 LINKS =',I5,11X,'NUMBER OF RIVER REACHES =',I3,//
      110X,'CALENDAR YEAR OPERATION STARTS =',I5,7X,
      1'NUMBER OF YEARS TO SIMULATE =',I3//18X,'NUMBER OF DEMAND NOD
      2ES =',I5,13X,'NUMBER OF SPILL NODES =',I3//11X,'NO OF RESERV',
      1'OIRS WHERE R.F USED=',I5,23X,'IMPORT NODE =',I3)
      WRITE (KOUT,15)
15    FORMAT(///10X,'NODE NO.',3X,'NODE NAME',4X,9(1H-),
      1' CAPACITIES ',9(1H-),5X,'YEARLY',10X,'TURBINE'/36X,'MAXIMUM   MINIMUM
      1   STARTING',5X,'DEMAND',5X,'CAPACITY IN M.W')
      DO 5 J=1,NJ
      IF(J.NE.20)GO TO 5
      WRITE (KOUT,11) TITLE
      WRITE(KOUT,15)
5     WRITE(KOUT,17)J,(RNAME(J,I),I=1,2),RCAP(J),RMIN(J),FSTART(J),DEM(J),
      1MWP(J)
17    FORMAT(/10X,I3,8X,2A4,4X,2I10,1X,I10,3X,I8,6X,I5)
C     WRITE(KOUT,11) TITLE
      WRITE(KOUT,19)
19    FORMAT(//10X,'SYSTEM CONFIGURATION',//10X,'LINK NO.',4X,'FROM
      1  NODE',5X,'TO NODE',7X,'MAX. CAPACITY',4X,'MIN. CAPACITY')
      DO 10 L=1,NL
      IF (MOD(L,20).NE.0) GO TO 10
C     WRITE(KOUT,11) TITLE
      WRITE(KOUT,19)
10    WRITE(KOUT,21) L,(LNODE(L,I),I=1,2),CMAX(L),CMIN(L)
21    FORMAT(/10X,2X,I2,12X,I2,12X,I2,9X,I10,7X,I10)
      WRITE(KOUT,23) (SP(I),I=1,NS)
23    FORMAT(///10X,'LIST OF SPILL RESERVOIRS - ',14I5)
      WRITE(KOUT,25) IMPRT,DIMP
25    FORMAT(//10X,'YEARLY IMPORT QUANTITY = ',I8//10X,
      1'10 DAILY IMPORT DISTRIBUTION -    '12F5.2,/2(44X,12F5.2/))
      WRITE(KOUT,24) (JESVOL(I),I=1,NSRS)
24    FORMAT(//10X,'SUB-SYSTEM OF RESERVOIRS ',14I5)
      WRITE(KOUT,26) AVRGLO,AVRGHI
26    FORMAT(//10X,'AVERAGE DEFINED AS BETWEEN',F5.2,' AND',
      1F5.2,'  FRACTION FULL OF SUBSYSTEM')
      WRITE(KOUT,22) CONFLO,CONINF,CONDEM
22    FORMAT(//10X,'FACTORS'//15X,
      1'MULTIPLY LINK CAPACITIES BY ',F8.3//15X,'MULTIPLY INFLOWS BY
      1 ....... ',F8.2//15X,'MULTIPLY DEMANDS
```

```
      1 BY  ,,,,,,, ',F8.2)
C     WRITE(KOUT,11) TITLE
      WRITE(KOUT,27)
27    FORMAT(//40X,'10 DAILY DEMAND DISTRIBUTION',53X,' * RANK *',
      1/1X,'NODE NO.',35X,' 10 DAILY PERIODS',58X,' AVG DRY WET'/)
      WRITE(KOUT,29) (J,(DEMD(J,K),K=1,36),(DEMR(J,I),I=1,3),J=1,NJ)
29    FORMAT(3X,I2,2X,18F6.2/,7X,18F6.2,3X,3I4)
C     WRITE(KOUT,11) TITLE
      WRITE(KOUT,31)
31    FORMAT(//2X,'RES NO.'33X'DESIRED 10 DAILY STORAGE LEVEL
      1(PERCENT FULL)'/)
      DO 32 J=1,NRES
      IF (MOD(J,8).EQ.0) WRITE(KOUT,11)
32    WRITE(KOUT,33)J,(COND(L),(OPRR(L,J,I),I=1,36),OPRP(L,J),L=1,3)
33    FORMAT((3X,I2,3X,A4,3X,18F6.2/15X,18F6.2,1X,I4)/(8X,A4,3X,18F6.2
      1/15X,18F6.2,1X,I4))
      WRITE(KOUT,35)
35    FORMAT(//40X,'RESERVOIRS AREA - CAPACITY TABLES  '//)
      K=0
      N2=0
40    K=K+1
      N1=N2+1
      N2=K*6
      IF(N1.GT.NRES)N1=0
      IF(N2.GT.NRES) N2=NRES
      IF(N1.EQ.0) GO TO 46
      IF(K.GT.1) WRITE(KOUT,11)
      WRITE(KOUT,41)(KRS,KRS=N1,N2)
41    FORMAT(6X,6(6X,'RESERVOIR NO.',I2)/1X,'POINT',6(5X,'AREA'
      1,1X,2X,'CAPACITY'))
      DO 45 NPT=1,18
45    WRITE(KOUT,43) NPT,((ACTAB(JN,NPT,K),K=1,2),JN=N1,N2)
43    FORMAT(2X,I2,2X,6(I9,1X,I10))
      GO TO 40
46    CONTINUE
47    CONTINUE
      WRITE(KOUT,120)
120   FORMAT(/10X,'ELEVATION  AREA  TABLE'/10X,21(1H*))
      DO 205 I=1,NRES
      IF(NPRES(I).LT.0) GO TO 205
      WRITE(KOUT,210) I
210   FORMAT(/23X,'RESERVOIR NO:',I4/)
      WRITE(KOUT,125)  ((EATAB(I,J,K),K=1,2),J=1,18)
125   FORMAT(4X,2F10.1,4X,2F10.1,4X,2F10.1)
205   CONTINUE
      WRITE(KOUT,130)
130   FORMAT(/10X,'TAIL WATER LEVEL DISCHARGE TABLE'/10X,32(1H*))
      DO 215 I=1,NRES
      IF(NPRES(I).LT.0) GO TO 215
      WRITE(KOUT,210) I
```

```
      WRITE(KOUT,125)  ((TWTAB(I,J,K),K=1,2),J=1,18)
215   CONTINUE
225   FORMAT(/10X,'HEAD-DISCHARGE  POWER TABLE IN M.W FOR RESERVOIR:',I4/)
      DO 114 N=1,NRES
      IF(NPRES(N)) 114,113,114
113   WRITE(KOUT,225) N
      WRITE(KOUT,230)
230   FORMAT(60X,'HEAD')
       WRITE(KOUT,112) (ROW(N,L),L=1,NROW(N))
      WRITE(KOUT,235)
      DO 116  J=1,NCOL(N)
235   FORMAT(1X,'DISCHARGE')
      WRITE(KOUT,115)  COL(N,J),(F(N,I,J),I=1,NROW(N))
112   FORMAT(13X,8F10.2)
115   FORMAT(1X,F10.2,2X,8F10.2)
116   CONTINUE
114   CONTINUE
      WRITE(KOUT,176)
176   FORMAT(//15X,'CUMULATIVE INDENT ON RESERVOIR FROM JUNE 1 ST'/15X,40
      1(1H*)/20X,'(TABLE STARTS FROM JAN 1 ST)'/)
      DO 180 I=1,NRF
      WRITE(KOUT,210) I
      WRITE(KOUT,184) (EXOUT(I,J),J=1,36)
184   FORMAT(1X,12F10.1)
180   CONTINUE
      WRITE(KOUT,185)
185   FORMAT(//15X,'CUMULATIVE AVAILABLABLE INFLOW FROM JUNE 1 ST'/15X,40
      1(1H*)/20X,'(TABLE STARTS FROM JAN 1 ST)')
      DO 190 I=1,NRF
      WRITE(KOUT,210) I
      WRITE(KOUT,184) (EXINF(I,J),J=1,36)
190   CONTINUE
      WRITE(KOUT,192)
192   FORMAT(//15X,'AVERAGE FLOW INTO THE RESERVOIRS'/15X,32(1H*))
      DO 195 I=1,NRF
      WRITE(KOUT,210) I
      WRITE(KOUT,184)  (ARF(I,J),J=1,36)
195   CONTINUE
      WRITE(KOUT,250)
250   FORMAT(/16X,' NORMAL STORAGE FOR UNIT R.F'/16X,27(1H*)/)
      DO 196 I=1,NRF
      WRITE(KOUT,210) I
196   WRITE(KOUT,184)  (ST(I,MON),MON=1,36)
      RETURN
      END


      SUBROUTINE OUT2(IY)
      INTEGER RCAP ,RMIN,FSTART,RLAD,RLON,ACTAB,DEM,DEMR,OPRP,SP
```

```
      COMMON /CONTRL/KIN,KOUT,KAPE1
      COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
     1,NPRES(20),ACTAB(20,20,2),OPRR(3,20,36),OPRF(3,10),SP(20),DEM
     2(20),DEMR(20,3),DEMD(20,36),EVAP(20,36),U(20,36),UIMP(36),IMPRT,
     3ARF(15,36),AREG(36),RVCAP(20,36),MWF(20)
      COMMON/PARM/NJ,NRES,NJUNC,NL,NO,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
     1NR
      COMMON/PRNT/ICAP(20,36,13),TOTLS(20,20,36)
      COMMON/LNKFLW/LNKFLO(200,37),LNKAFL(200,37),LNKMX(200,37)
      COMMON/POW/ NROW(5),NCOL(5),F(5,25,25),EATAB(5,18,2),TWTAB(5,18,2),
     1PLTAB(5,18,2),
     1HNET(36,5),FDIS(36,5),CELE(36,5),CTWL(36,5),ROW(5,25),
     1COL(5,25),AREA(36,5),HYDL(20)
      COMMON/DPL/DLX(50,5),DDLX(50,5),DLY(50,5),DDLY(50,5),AP(50,5),AQ(50,5),
     1POWR(50,5)
      COMMON/RFAC/NODMP(15),NADMP(15,15),EXOUT(15,36),FAC(15,36),IAVEF(15,37)
     1,NRF,EXINF(15,36),ST(15,36)
      COMMON/DEMON/DEMON(20,36)
      ICALYR=IYEAR-1+IY
      KTD=0
      TYPE *,(NPRES(I),I=1,NRES)
      DO 30 J=1,NJ
      IF(MOD(J,2).EQ.1.OR.J.EQ.1) WRITE(KOUT,11) TITLE,IY,ICALYR
11    FORMAT(//20X,20A4//5X'SIMULATION YEAR',I3,5X,'CALENDAR
     1 YEAR',I5)
      IF(J.GT.NRES) GO TO 25
      WRITE(KOUT,14) J,(RNAME(J,I),I=1,2),RCAP(J),RMIN(J)
14    FORMAT(/21X,'RESERVOIR NO',I3,2X,2A4,4X,'MAX. CAPACITY',I8,
     12X,'MIN. OPERATING POOL',I8)
      WRITE(KOUT,16)
16    FORMAT(/,5X,' INITIAL',4X,'UREG',2X,'UPSTRM',9X,'SURFACE',
     12X,'EVAP',4X,'EVAP DOWNSTRM',9X,'DIVERTED',1X,'DIVERTED',
     22X,'SYSTEM',1X,'END PER',2X,'OPERTG'3X,'RF',4X,'ACT'/1X,'PERID
     3SRORAGE INFLOWS  SPILLS  DEMAND   AREA  RATE   LOSS   SP
     4ILLS SHORTAGE   INTO     OUT     LOSS  CONTENT     RULE',8X,'DEMD')
      DO 17 MON=1,36
17    WRITE(KOUT,18) MON,(ICAP(J,MON,I),I=1,5),EVAP(J,MON),(ICAP
     1(J,MON,I),I=6,13),FAC(J,MON),DEMON(J,MON)
18    FORMAT(1X,I2,1X,5I8,1X,F5.2,1X,I5,2I8,I8,4I9,F7.3,1X,F8.0)
      WRITE(KOUT,20) (TOTLS(J,IY,I),I=2,4),(TOTLS(J,IY,I),I=6,11),TOTLS
     1(J,IY,13)
20    FORMAT(/5X,'YEAR TOTALS ',3F9.0,15X,3F9.0,F8.0,2F9.0,8X,F10.0)
      GO TO 30
25    WRITE(KOUT,26) J,(RNAME(J,I),I=1,2)
26    FORMAT(/21X,'DEMAND NODE',I3,2X,2A4//21X,'MONTH',9X,'DEMAND'
     1,5X,10H SHORTAGE,5X,'UREG.FLOW',4X,'ACT.DEMD')
      DO 27 MON=1,36
27    WRITE(KOUT,28) MON,ICAP(J,MON,4),ICAP(J,MON,8),ICAP(J,MON,2),DEMON
     1(J,MON)
28    FORMAT(21X,I3,7X,I10,2(5X,I10),4X, F9.1)
```

```
      WRITE(KOUT,29) TOTLS(J,IY,4),TOTLS(J,IY,8),TOTLS(J,IY,2),TOTLS
     1(J,IY,13)
29    FORMAT(20X,' YEAR TOTALS',4(F10.0,5X))
30    CONTINUE
      WRITE(KOUT,11) TITLE,IY,ICALYR
      WRITE(KOUT,32) (I,I=1,NL)
32    FORMAT(/10X,'LINK NO',7I10/4X,'PERIOD')
      DO 35 L=1,NL
      LNKFLO(L,37)=0
      DO 33 I=1,36
      LNKFLO(L,37)=LNKFLO(L,37)+LNKFLO(L,I)/36
33    CONTINUE
35    CONTINUE
      DO 34 I=1,36
34    WRITE(KOUT,38) I,(LNKFLO(L,I),L=1,NL)
      WRITE(KOUT,37) (LNKFLO(L,37),L=I,NL)
37    FORMAT(10X,'AVERAGE',7I10)
38    FORMAT(8X,I2,7X,7I10)
      CALL POW
      RETURN
      END


      SUBROUTINE OUT3
      COMMON /CONTRL/KIN,KOUT,KAPE1
      COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
     1NR
      COMMON/PRNT/ICAP(20,36,13),TOTLS(20,20,36)
      COMMON/LNKFLW/LNKFLO(200,37),LNKAFL(200,37),LNKMX(200,37)
      DIMENSION AVE(2),XMA(2)
      DIMENSION DNA(2)
      DATA AVE/'AVER','AGE '/,XMA/'MAXI','MUM '/
      DATA DNA/'NODE','YEAR'/
      IPTOB=0
      IPTOU=0
      IPTOI=0
      IPTOD=0
      IPTOS=0
      IPTOL=0
      IPTOG=0
      IPTOAD=0
      DO 4 KY=1,NYEAR
      WRITE(KOUT,11) TITLE,DNA(2),KY,DNA(1)
      DO 4 J=1,NJ
      WRITE(KOUT,12) J,(TOTLS(J,KY,N),N=1,2),TOTLS(J,KY,4),
     1TOTLS(J,KY,8),TOTLS(J,KY,6),(TOTLS(J,KY,N),N=11,12),TOTLS(J,KY,13)
      DO 7 J =1, NJ
      WRITE(KOUT,11) TITLE,DNA(1),J,DNA(2)
      DO 6 KY=1,NYEAR
```

```
      WRITE(KOUT,12) KY,(TOTLS(J,KY,N),N=1,2),TOTLS(J,KY,4),
     1TOTLS(J,KY,8),TOTLS(J,KY,6),(TOTLS(J,KY,N),N=11,12),TOTLS(J,KY,13)
      IPTOB=IPTOB+TOTLS(J,KY,1)
      IPTOU=IPTOU+TOTLS(J,KY,2)
      IPTOD=IPTOD+TOTLS(J,KY,4)
      IPTOS=IPTOS+TOTLS(J,KY,8)
      IPTOE=IPTOE+TOTLS(J,KY,6)
      IPTOL=IPTOL+TOTLS(J,KY,11)
      IPTOG=IPTOG+TOTLS(J,KY,12)
      IPTOAD=IPTOAD+TOTLS(J,KY,13)
6     CONTINUE
      WRITE(KOUT,13) IPTOU,IPTOD,IPTOS,IPTOE,IPTOL,IPTOAD
      IPTOU=IPTOU/NYEAR
      IPTOD=IPTOD/NYEAR
      IPTOS=IPTOS/NYEAR
      IPTOE=IPTOE/NYEAR
      IPTOL=IPTOL/NYEAR
      IPTOAD=IPTOAD/NYEAR
      WRITE(KOUT,14) IPTOU,IPTOD,IPTOS,IPTOE,IPTOL,IPTOAD
      IPTOB=0
      IPTOU=0
      IPTOD=0
      IPTOS=0
      IPTOE=0
      IPTOL=0
      IPTOG=0
      IPTOAD=0
7     CONTINUE
      KY=100000
      WRITE(KOUT,11)TITLE,DNA(2),KY,DNA(2)
11    FORMAT(//////20X,20A4//,20X,'SIMULATION PERIOD TOTAL SUMMARY BY
     1 ',A4,I8//,5X,A4,' START. STRG. UNREG. FLOW       DEMANDS
     1   SHORTAGES  EVAPORATION  SYSTEM LOSS ENDING STRG.  AC.DEMAND')
      DO 15 KY=1,NYEAR
      DO 10 J=2,NJ
      DO 8 N=1,13
      TOTLS(1,KY,N)=TOTLS(1,KY,N)+TOTLS(J,KY,N)
8     CONTINUE
10    CONTINUE
      WRITE(KOUT,12) KY,(TOTLS(1,KY,N),N=1,2),TOTLS(1,KY,4),
     1TOTLS(1,KY,8),TOTLS(1,KY,6),(TOTLS(1,KY,N),N=11,12),TOTLS(1,KY,13)
12    FORMAT(5X,I4,8F13.0)
      IPTOB=IPTOB+TOTLS(1,KY,1)
      IPTOU=IPTOU+TOTLS(1,KY,2)
      IPTOD=IPTOD+TOTLS(1,KY,4)
      IPTOS=IPTOS+TOTLS(1,KY,8)
      IPTOE=IPTOE+TOTLS(1,KY,6)
      IPTOL=IPTOL+TOTLS(1,KY,11)
      IPTOG=IPTOG+TOTLS(1,KY,12)
      IPTOAD=IPTOAD+TOTLS(1,KY,13)
```

```
15      CONTINUE
        WRITE(KOUT,13) IPTOU,IPTOD,IPTOS,IPTOE,IPTOL,IPTOAD
13      FORMAT(//6X,'PERIOD TOTALS',3X,5I13,13X,I13)
        IPTOU=IPTOU/NYEAR
        IPTOD=IPTOD/NYEAR
        IPTOS=IPTOS/NYEAR
        IPTOE=IPTOE/NYEAR
        IPTOL=IPTOL/NYEAR
        IPTOAD=IPTOAD/NYEAR
        WRITE(KOUT,14) IPTOU,IPTOD,IPTOS,IPTOE,IPTOL,IPTOAD
14      FORMAT(//4X,'PERIOD AVERAGES',3X,5I13,13X,I13)
16      FORMAT(/20X,20A4/20X,'SIMULATION
        1 PERIOD',1X,2A4,1X,' 10-DAILY FLOWS'//1X,'LINK NO'3X, 7(8X,I2)
        2/'SEASON NO .')
        DO 20 I=1,36
        IF(I.EQ.1) WRITE(KOUT,16)TITLE,AVE,(L,L=1,NL)
20      WRITE(KOUT,17)I,(LNKAFL(L,I),L=1,NL)
17      FORMAT(6X,I4,1X, 7I10)
        DO 24 I=1,36
        IF(I.EQ.1) WRITE(KOUT,16) TITLE,XMA,(L,L=1,NL)
24      WRITE(KOUT,17) I,(LNKMX(L,I),L=1,NL)
        RETURN
        END


        SUBROUTINE SETNET
        COMMON /CONTRL/KIN,KOUT,KAPE1
        COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,IMP,TITLE(20),NR
        COMMON/LINK/LNODE(200,2),CMAX(200),CMIN(200)
        COMMON/ADATA/NARC,NMAX,FESIBL,NTIME
        1,NT(400),NF(400),HI(400),LO(400),FLOW(400),COST(400)
        DO 5 L=1,NL
        NF(L)=LNODE(L,1)
        NT(L)=LNODE(L,2)
5       CONTINUE
        NARC=NL
        N=NJ+1
        DO 7 K=1,NJ
        NARC=NARC+1
        NF(NARC)=N
        NT(NARC)=K
7       CONTINUE
        N=NJ+2
        DO 9 K=1,NJ
        NARC=NARC+1
        NF(NARC)=K
        NT(NARC)=N
9       CONTINUE
        DO 11 K=1,NJ
```

```
      NARC=NARC+1
      NF(NARC)=K
      NT(NARC)=N
11    CONTINUE
      N=NJ+3
      DO 13 K=1,NJ
      NARC=NARC+1
      NT(NARC)=N
      NF(NARC)=K
13    CONTINUE
      N=NJ+4
      IF(NRES.EQ.0) GO TO 20
      DO 15 K=1,NRES
      NARC=NARC+1
      NT(NARC)=N
      NF(NARC)=K
15    CONTINUE
20    CONTINUE
      NMAX=NJ+5
      NF(NARC+1)=NJ+2
      NT(NARC+1)=NMAX
      NF(NARC+2)=NJ+4
      NT(NARC+2)=NMAX
      NF(NARC+3)=NJ+3
      NT(NARC+3)=NMAX
      NF(NARC+4)=NMAX
      NT(NARC+4)=NJ+1
      NARC=NARC+4
      RETURN
      END


      SUBROUTINE SUPERK
      COMMON/ADATA/NR,NN,FESIBL,NTIME,
      1NA(400),NF(400),JSAVE(400),ILO(400),NC(400),ISAVE(400)
      COMMON IWV(100),LABL(100),NODE(100),MIDL(100),KOS(400),MIR(400)
      COMMON JWV(400),NSAVE(100)
      LOGICAL FESIBL
      MAXA=200
      FESIBL=.TRUE.
      INFIN= 100 000 000
      IFLOW=0
      KLAB=0
      KPOT=0
      KBRK=0
      IP=0
      NUMS=0
      IPL=0
      NR2=NR*2
```

```
      NN1=NN+1
      IF(NTIME.GT.1) GO TO 12
      DO 5 I=1,NN1
      NODE(I)=0
5     LABL(I)=0
      DO 10 M=1,NR
      N=M+NR
      I=NF(M)
      J=NA(M)
      IFLOW=NC(M)
      KOST=ISAVE(M)
      NODE(I)=NODE(I)+1
      NODE(J)=NODE(J)+1
      NA(N)=I
      KOS(M)=KOST
      KOS(N)=-KOST
      NC(M)=JSAVE(M)-IFLOW
      NC(N)=IFLOW-ILO(M)
10    CONTINUE
      DO 11 I=1,NN1
11    NSAVE(I)=NODE(I)
      GO TO 1401
12    DO 13 I=1,NN1
      NODE(I)=NSAVE(I)
13    LABL(I)=0
      DO 14 M=1,NR
      N=M+NR
      IFLOW=NC(M)
      KOST=ISAVE(M)+KOS(M)
      KOS(M)=KOST
      KOS(N)=-KOST
      NC(M)=JSAVE(M)-IFLOW
      NC(N)=IFLOW-ILO(M)
14    CONTINUE
1401  CONTINUE
      KL=1
      DO 15 K=1,NN1
      JK=NODE(K)
      NODE(K)=KL
      JWV(K)=KL
      KL=JK+KL
15    MIDL(K)=KL-1
      DO 20 L=1,NR
      LL=L+NR
      J=NA(L)
      I=NA(LL)
      KOST=KOS(L)
      K=NC(L)
      LO=-NC(LL)
      MAIN=2
```

```
      MIRROR=2
      IF(KOST) 29,29,30
29    IF(K)32,32,31
30    IF(LO)35,36,31
31    MAIN=1
32    IF(KOST)33,34,34
33    IF(K) 35,36,36
34    IF(LO)35,36,36
35    MIRROR=1
36    GO TO (43,44),MAIN
43    II=JWV(I)
      MIR(II)=L
      JWV(I)=II+1
      GO TO 45
44    II=MIDL(I)
      MIR(II)=L
      MIDL(I)=II-1
45    GO TO(46,47),MIRROR
46    II=JWV(J)
      MIR(II)=LL
      JWV(J)=II+1
      GO TO 20
47    II=MIDL(J)
      MIR(II)=LL
      MIDL(J)=II-1
20    CONTINUE
      NR=INFIN
      NR2=NR*2
      DO 1000 MAIN=1,NR
      MAINM=MAIN+NR
      DO 1000 MODE =1,2
      GO TO (52,53),MODE
52    II=MAIN
      JZ=MAINM
      GO TO 54
53    II=MAINM
      JZ=MAIN
54    IF(NC(II)) 65,55,56
55    IF(NC(JZ)) 63,990,990
56    IF(KOS(II))63,55,55
63    IS=NA(JZ)
      JS=II
      IT=NA(II)
      JT=JZ
      GO TO 70
65    IT=NA(JZ)
      IS=NA(II)
      JS=JZ
      JT=II
70    IPL=1
```

```
      IPLL=1
      IPS=0
      NUMS=0
      LABL(IT)=JS
      IWV(IPL)=IT
84    KLAB=KLAB+1
      GO TO 86
85    IF(IPS-IPL)86,200,86
86    IPS=IPS+1
      IA=IWV(IPS)
      IB=NODE(IA)
      IE=MIDL(IA)
      IF(IB-IE) 87,87,85
87    DO 90 JJ=IB,IE
      J=MIR(JJ)
      NUNODE=NA(J)
      IF(LABL(NUNODE)) 90,88,90
88    LABL(NUNODE)=J
      IPL=IPL+1
      IWV(IPL)=NUNODE
      IF(NUNODE-IS) 90,96,90
90    CONTINUE
      GO TO 85
96    KBRK=KBRK+1
97    IALPHA=INFIN
      K=0
      NOW=IS
100   IJ=LABL(NOW)
      JI=IJ-NR
      IF(JI) 101,101,102
101   JI=JI+NR2
102   NEXT=NA(JI)
      K=K+1
      IF(KOS(IJ)) 105,105,104
104   NET=-NC(JI)
      JWV(K)=NET
      GO TO 110
105   NET=NC(IJ)
      JWV(K)=NET
110   IALPHA=MINO(IALPHA,NET)
      IF(NEXT-IS) 111,120, 111
111   NOW=NEXT
      GO TO 100
120   K=0
      NOW=IS
125   IJ=LABL(NOW)
      JI=IJ-NR
      IF(JI) 126,126,127
126   JI=JI+NR2
127   NEXT=NA(JI)
```

```
      K=K+1
      NC(IJ)=NC(IJ)-IALPHA
      NET=NC(JI)
      NETNU=NET+IALPHA
      NC(JI)=NETNU
      IF(KOS(JI)) 128,1271,128
1271  IF(NET) 1272,1272,128
1272  IF(NETNU)128,128,1273
1273  CALL LEFT(NOW,JI)
128   IF(JWV(K)-IALPHA) 129,1281,129
1281  CALL RIGHT(NEXT,IJ)
129   IF(NEXT-IS) 130,150, 130
130   NOW=NEXT
      GO TO 125
150   DO 155 I=1,IPL
      J=IWV(I)
155   LABL(J)=0
      GO TO 54
200   KPOT=KPOT+1
201   KSET=NUMS
      NEWLAB=0
      NUMS=0
      INTHRU=0
      MIN=INFIN
      NEW=NONS
      NONS=MAXA+1
      IF(KSET) 204,204,202
202   IF(NEW-MAXA) 295,295,312
295   MAXNEW=MAXA+NEW
      DO 310 L=NEW,MAXA
      K=MAXNEW-L
      KK=JWV(K)
      KKK=NA(KK)
      IF(LABL(KKK)) 310,300,310
300   NONS=NONS-1
      JWV(NONS)=KK
310   CONTINUE
312   DO 203 K=1,KSET
      KK=JWV(K)
      KKK=NA(KK)
      IF(LABL(KKK)) 203,2021,203
2021  IF(KOS(KK)) 2023,2023,2022
2022  NUMS=NUMS+1
      JWV(NUMS)=KK
      MIN=MINO(MIN,KOS(KK))
      GO TO 203
2023  NONS=NONS-1
      JWV(NONS)=KK
203   CONTINUE
204   CONTINUE
```

```
      IF(IPLL-IPL) 2039,2039,2111
2039  DO 211 LL=IPLL,IPL
      L=IWV(LL)
      JMID=MIDL(L)+1
      JRT=NODE(L+1)-1
      IF(JMID-JRT) 2045,2045,211
2045  DO 210 KK=JMID,JRT
      K=MIR(KK)
      I=NA(K)
      IF(LABL(I)) 210,2040,210
2040  IF(NC(K)) 206,2041,2041
2041  IF(KOS(K)) 206,206,205
205   NUMS=NUMS+1
      JWV(NUMS)=K
      MIN=MIN0(MIN,KOS(K))
      GO TO 210
206   NONS=NONS-1
      JWV(NONS)=K
210   CONTINUE
211   CONTINUE
2111  IPLL=IPL+1
      IF(NUMS) 212,212,215
212   FESIBL=.FALSE.
      CALL DUMPO(NR,II)
      PRINT 2125,IS,IT,II
      PRINT 2121,(I,LABL(I),I=1,NN)
      PRINT 2122,(I,IWV(I),I=1,IPL)
      PRINT 2123,(JWV(I),I=NEW,MAXA)
2121  FORMAT(' LABLES, BY NODE'/(5(I9,'=',I10)))
2122  FORMAT(' LABELED NODES (IWV)'/     (10I10))
2123  FORMAT(' THE SET (L,L-), NON-S'/(10I10))
2125  FORMAT('0IS=',I5,'   IT=',I5,10X,'INFEASIBLE ARC=',I5)
      RETURN
215   DO 230 I=1,NUMS
      IJ=JWV(I)
      JI=IJ-NR
      IF(JI) 216,216,217
216   JI=IJ+NR
217   KOST=KOS(IJ)-MIN
      KOS(IJ)=KOST
      KOS(JI)=-KOST
      IF(KOST) 230,218,230
218   IF(NC(IJ)) 230,230,220
220   NODEB=NA(IJ)
      CALL LEFT(NA(JI),IJ)
      IF(LABL(NODEB)) 230,223,230
223   LABL(NODEB)=IJ
      IPL=IPL+1
      IWV(IPL)=NODEB
      IF(NODEB-IS) 230,225,230
```

```
225    IMTHRU=1
230    CONTINUE
       IF(NONS-MAXA) 240,240,345
240    DO 270 I=NONS,MAXA
       IJ=JWV(I)
       JI=IJ-NR
       IF(JI) 242,242,244
242    JI=IJ+NR
244    KOSTA=KOS(IJ)
       KOSTB=KOSTA-MIN
       KOS(IJ)=KOSTB
       KOS(JI)=-KOSTB
260    IF(KOSTA) 270,262,262
262    IF(KOSTB) 264,270,270
264    IF(NC(IJ)) 270,269,269
269    IF(NC(JI)) 270,270,2691
2691   CALL RIGHT(NA(IJ),JI)
270    CONTINUE
C                              OUT OF KILTER CHECK
345    IF(NC(II)) 360,350,351
350    IF(NC(JZ)) 360,980,980
351    IF(KOS(II)) 360,350,350
360    IF(IMTHRU) 361,361,96
361    IF(IPS-IPL) 84,200,84
980    DO 981 I=1,IPL
       J=IWV(I)
981    LABL(J)=0
990    CONTINUE
1000   CONTINUE
       TOTAL=0.
       DO 1010 I=1,NR
       KOS(I)=KOS(I)-ISAVE(I)
       NC(I)=JSAVE(I)-NC(I)
C      TOTAL=TOTAL+NC(I)*ISAVE(I)
       IF(ISAVE(I).EQ.0) ISAVE(I)=1
       TOTAL=(TOTAL/ISAVE(I)+NC(I))*ISAVE(I)
1010   CONTINUE
       RETURN
       END
```

```
      SUBROUTINE RIGHT(I,INDEX)
      COMMON/ADATA/NR,NN,FESIBL,NTIME,NA(400),NF(400),JSAVE(400)
     1,ILO(400),NC(400),ISAVE(400)
      COMMON IWV(100),LABL(100),NODE(100),MIDL(100),KOS(400),MIR(400)
      COMMON JWV(400)
```

```
      MID=MIDL(I)
      IA=NODE(I)
      DO 1 II=IA,MID
      IF(MIR(II)-INDEX) 1,3,1
1     CONTINUE
      KWAY=1
2     WRITE(6,900) I,INDEX,KWAY
      IFROM=NODE(I)
      ITO=NODE(I+1)-1
      WRITE(6,910) IFROM,MIDL(I),ITO,(K,MIR(K),K=IFROM,ITO)
910   FORMAT(3I6/(20I6))
      RETURN
3     ITEMP=MIR(MID)
      MIR(MID)=INDEX
      MIR(II)=ITEMP
      MIDL(I)=MID-1
      RETURN
      ENTRY LEFT(I,INDEX)
      MID=MIDL(I)+1
      IB=NODE(I+1)-1
      DO 10 II=MID,IB
      IF(MIR(II)-INDEX) 10,12,10
10    CONTINUE
      KWAY=2
      GO TO 2
12    ITEMP=MIR(MID)
      MIR(MID)=INDEX
      MIR(II)=ITEMP
      MIDL(I)=MID
      RETURN
900   FORMAT('NODE' ,I5,'  ARC',I5,'LOST ON SHIFT ',I4,' LOC'
      ENTRY DUMPO(NLINES,ID)
      PRINT 1120,ID
      DO 1070 M=1,NLINES
      N=M+NR
      I=NA(N)
      J=NA(M)
      L=ILO(M)
      K=JSAVE(M)
      KOST=ISAVE(M)
      KBAR=KOS(M)
      IFLOW=K-NC(M)
      IF(IFLOW.LT.L.OR.IFLOW.GT.K) PRINT 1121
      IF(KBAR) 1065,1070,1067
1065  IF(IFLOW.LT.K) PRINT 1122
      GO TO 1070
1067  IF(IFLOW.GT.L) PRINT 1122
1070  PRINT 1125, M,I,J,L,K,IFLOW,KOST,KBAR
1125  FORMAT(3I5,3I10,5X,2I10)
1120  FORMAT('1 ARC    I    J          L          K        IFLOW
```

```
     1      KOST       KBAR',I15/)
1121  FORMAT('   THE FOLLOWING ARC IS PRIMAL INFEASIBLE')
1122  FORMAT('   THE FOLLOWING ARC IS DUAL INFEASIBL')
      RETURN
      END
```

```
      SUBROUTINE OPRATE
      LOGICAL FESIBL
      INTEGER HI,COST,FLOW,START,STEND,USE,UREG,ISHTM,
     1ISPIL,AREAX,EVPT,AMAX,AMIN
      INTEGER RCAP,RMIN,FSTART,ACTAB,DEM,
     1DEMR,OPRP,SP,CMAX,CMIN
      COMMON /CONTRL/KIN,KOUT,KAPE1
      COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
     1NR
      COMMON/WRKD/START(20),STEND(20),USE(20),UREG(20),ISHTM(20,36),
     1ISPIL(20,36),AREAX(20),EVPT(20),AMAX(20),AMIN(20),IAREA(20)
      COMMON/PRNT/ICAP(20,36,13),TOTLS(20,20,36)
      COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
     1,NPRES(20),ACTAB(20,20,2),OPRR(3,20,36),OPRP(3,10),SP(20),DEM
     1(20),DEMR(20,3),DEMD(20,36),EVAP(20,36),U(20,36),DIMP(36),IMPRT,
     1ARF(15,36),AREG(36),RVCAP(20,36),MWP(20)
      COMMON/LINK/LNODE(200,2),CMAX(200),CMIN(200)
      COMMON/LNKFLW/LNKFLO(200,37),LNKAFL(200,37),LNKMX(200,37)
      COMMON/ADATA/NARC,NMAX,FESIBL,NTIME,NT(400),NF(400)
     1,HI(400),LO(400),FLOW(400),COST(400)
      COMMON/KDATA/PI(400),LARCS(400),IPT(400),LIST(400)
      COMMON/CONFAC/AVRGLO,AVRGHI,CONFLO,CONDEM,CONINF,
     1CPCT,NSRS,LRULE,JESVOL(20)
      COMMON/DEMON/DEMON(20,36)
      COMMON/RFAC/NODMP(15),NADMP(15,15),EXOUT(15,36),FAC(15,36),IAVEP
     1(15,37),NRF,EXINF(15,36),ST(15,20)
      ROFF=0.499
       ITOT=0
      TYPE *,(NPRES(I),I=1,NRES)
      DO 2 L=1,NL
      DO 2 I=1,37
      LNKFLO(L,I)=0
      LNKAFL(L,I)=0
      IAVEP(L,I)=0
      LNKMX(L,I)=0
2     CONTINUE
      DO 4 J=1,NJ
      START(J)=0
      STEND(J)=0
      EVPT(J)=0
      ITOT=ITOT+RCAP(J)
      DO 4 N=1,36
      ISHTM(J,N)=0
      ISPIL(J,N)=0
4     CONTINUE
C                       SET LIMITS ON ARCS
      L1=NL+1
      L2=NL+NJ
      L3=L2+1
      L4=L2+NJ
```

```
      L5=L4+1
      L6=L4+NJ
      L7=L6+1
      L8=L6+NJ
      L9=L8+1
      LA=L8+NRES
      LB=NR+1
      DO 5 L=1,NARC
      HI(L)=0
      LO(L)=0
      FLOW(L)=0
      COST(L)=0
5     CONTINUE
      DO 7 L=1,NL
      HI(L)=CMAX(L)*CONFLO
      LO(L)=CMIN(L)*CONFLO
      COST(L)=0
7     CONTINUE
      DO 8 L=1,NL
      COST(L)=1
      IF(L.GT.NR) COST(L)=2
8     CONTINUE
      CALL AREA(RCAP,AMAX)
      CALL AREA(RMIN,AMIN)
      REWIND KAPE1
      ISTRT=1
      NYR=NYEAR
      NTIME=1
      DO 300 IY=ISTRT,NYR
      DO 12 J=1,NJ
      DO 12 I=1,13
      TOTLS(J,IY,I)=0
12    CONTINUE
      CALL DATA2
      IF(IY.GT.1) GO TO 10
      IF(NRES.EQ.0) GO TO 50
      DO 14 J=1,NRES
      STEND(J)=FSTART(J)
14    CONTINUE
50    CONTINUE
C                      ENTER SEASONAL LOOP
10    DO 200 MON=1,36
      IFLAG=0
      GO TO 11
43    IFLAG=1
11    DO 16 J=1,NJ
      USE(J)=0
      EVPT(J)=0
      UREG(J)=0
      START(J)=0
```

```
        DO 16 I=1,13
       ICAP(J,MON,I)=0
16     CONTINUE
       DO 17 L=1,NARC
       FLOW(L)=0
17     CONTINUE
       DO 19 J=1,NJ
       USE(J)=IFIX(DEMON(J,MON))
       IF(DEM(J).GT.0) USE(J)=DEM(J)*DEMD(J,MON)+ROFF
       UREG(J)=IFIX(U(J,MON))
       START(J)=STEND(J)
19     CONTINUE
       DO 21 J=1,NRES
21     AREG(J)=ARF(J,MON)
       IF(MON.GE.16.AND.MON.LE.27.OR.IFLAG.EQ.1) GO TO 25
       DO 100 I=1,NRF
       FAC(I,MON)=(STEND(I)-RMIN(I)+EXINF(I,MON))/EXOUT(I,MON)
       IF(FAC(I,MON).GE.1.0) GO TO 112
       DO 102 L=1,NODMP(I)
       DO 103 J=1,NJ
103    IF(NADMP(I,L).EQ.J) USE(J)=USE(J)*FAC(I,MON)
102    CONTINUE
       GO TO 100
112    FAC(I,MON)=1.0
100    CONTINUE
       GO TO 20
25    DO 30 I=1,NRF
30     FAC(I,MON)=1.0
20     MOIMP=IMPRT*DIMP(MON)+ROFF
       IF(IMP.NE.0) UREG(IMP)=UREG(IMP)+MOIMP
       CALL AREA(START,AREAX)
       CALL RULE(MON)
       ISUM=0
       LO(NARC-3)=0
       DO 28 L=L1,L2
       JN=NT(L)
       LO(L)=START(JN)+UREG(JN)
       HI(L)=LO(L)
       FLOW(L)=LO(L)
       ISUM=ISUM+FLOW(L)
       NP=L+NJ
       NN=L+2*NJ
       IF(RCAP(JN).EQ.0) GO TO 26
       IA=0
       IB=0
       XI=1.0
       IA=0.5*(AREAX(JN)+AMAX(JN))*EVAP(JN,MON)*XI+ROFF
       IB=0.5*(AREAX(JN)+AMIN(JN))*EVAP(JN,MON)*XI+ROFF
       MINPOL=RMIN(JN)
       LO(NP)=IB+MINPOL
```

```
      IF(LO(L).LT.LO(NP))LO(NP)=LO(L)
      IF(LO(NP).LT.0) LO(NP)=0
      LO(NN)=0
      HI(NP)=OPRR(LRULE,JN,MON)*ST(JN,MON)+IA
      IF(HI(NP).LE.RMIN(JN)) HI(NP)=RMIN(JN)
      COST(NP)=-(1000-OPRP(LRULE,JN)*10)
      HI(NN)=RCAP(JN)-HI(NP)+IA
      IF(IVCAP(JN).GT.0) HI(NN)=RVCAP(JN,MON)-HI(NP)+IA
      IF(HI(NN).LT.0) HI(NN)=0
      IF(HI(NP).GT.LO(NP)) GO TO 26
      HI(NP)=LO(NP)
      HI(NN)=RCAP(JN)-HI(NP)
      IF(IVCAP(JN).GT.0) HI(NN)=RVCAP(JN,MON)-HI(NP)
      IF(HI(NN).LT.0) HI(NN)=0
26    CONTINUE
      FLOW(NN)=FLOW(L)
      LO(NARC-3)=LO(NARC-3)+LO(NP)
28    CONTINUE
      FLOW(NARC-3)=ISUM
      HI(NARC-3)=ITOT
      FLOW(NARC)=ISUM
      HI(NARC)=FLOW(NARC)
      LO(NARC)=FLOW(NARC)
      MAXD=0
      DO 32 L=L7,L8
      JN=NF(L)
      HI(L)=USE(JN)
      COST(L)=-(1000-DEMR(JN,LRULE)*10)
      MAXD=MAXD+HI(L)
32    CONTINUE
      HI(NARC-1)=MAXD
C     SPILL ARCS
      MAXS=0
      DO 34 L=L9,LA
      JN=NF(L)
      NTX=0
      DO 36 K=1,NS
      IF(JN.EQ.SP(K).AND.NS.NE.0)NTX=1
      IF(NTX.EQ.1) GO TO 33
36    CONTINUE
      K=0
33    KS=K
      HI(L)=ITOT*10*NTX
      COST(L)=NTX*10000*(1+KS)
      MAXS=MAXS+HI(L)
34    CONTINUE
      HI(NARC-2)=MAXS
      CALL SUPERK
      NTIME=1
      IF(.NOT.FESIBL) GO TO 450
```

```
      INDI=0
      DO 42 L=L7, L8
      JN=NF(L)
      IF(IFIX(DEMON(JN,MON)).EQ.USE(JN)) INDI=1
      ISHTM(JN,MON)=IFIX(DEMON(JN,MON))-FLOW(L)
 42   CONTINUE
      DO 44 L=L9,LA
      JN=NF(L)
      ISPIL(JN,MON)=FLOW(L)
      IF(IFLAG.EQ.0.AND.ISPIL(JN,MON).GT.0.AND.INDI.NE.1) GO TO 43
 44   CONTINUE
      DO 58 L=L3,L4
      JN=NF(L)
      LN=L+NJ
      STEND(JN)=0
      STEND(JN)=FLOW(L)+FLOW(LN)
 58   CONTINUE
      CALL AREA(STEND,IAREA)
      DO 60 L=L3,L4
      JN=NF(L)
      XI=1.0
      EVPT(JN)=0.5*(AREAX(JN)+IAREA(JN))*EVAP(JN,MON)*XI+ROFF
      STEND(JN)=STEND(JN)-EVPT(JN)
      IF(STEND(JN).LT.0) STEND(JN)=0
      IF(IVCAP(JN).GT.0.AND.STEND(JN).GE.RVCAP(JN,MON)) STEND(JN)=RVCAP
     1(JN,MON)
 60   CONTINUE
      IF(NRES.EQ.0) GO TO 250
      DO 72 J=1,NRES
      ICAP(J,MON,1)=START(J)
      ICAP(J,MON,2)=UREG(J)
      ICAP(J,MON,4)=USE(J)
      ICAP(J,MON,5)=0.5*(AREAX(J)+IAREA(J))+ROFF
C     TYPE 506, ICAP(J,MON,5)
506   FORMAT(2X,'ICAP='I8)
      ICAP(J,MON,6)=EVPT(J)
      ICAP(J,MON,8)=ISHTM(J,MON)
      ICAP(J,MON,11)=ISPIL(J,MON)
      ICAP(J,MON,12)=STEND(J)
      ICAP(J,MON,13)=OPRR(LRULE,J,MON)*ST(J,MON)+ROFF
      IF(ICAP(J,MON,13).LE.RMIN(J)) ICAP(J,MON,13)=RMIN(J)
      IDN=0
      IUP=0
      IPI=0
      IPO=0
      IF(NR.EQ.0)GO TO 65
      DO 66 L = 1,NR
      LNKFLO(L,MON)=FLOW(L)/CONFLO
      IF(LNODE(L,1).EQ.J)IDN=IDN+FLOW(L)
      IF(LNODE(L,2).EQ.J)IUP=IUP+FLOW(L)
```

```
66      CONTINUE
825     FORMAT(1X,'825')
        ICAP(J,MON,3)=IUP
        ICAP(J,MON,7)=IDN
65      IF(NC.EQ.0)GO TO 67
        DO 68 L=LB,NL
        LNKFLO(L,MON)=FLOW(L)/CONFLO
        IF(LNODE(L,1).EQ.J)IPO=IPO+FLOW(L)
        IF(LNODE(L,2).EQ.J)IPI=IPI+FLOW(L)
68      CONTINUE
67      CONTINUE
        ICAP(J,MON,9)=IPI
        ICAP(J,MON,10)=IPO
72      CONTINUE
250     CONTINUE
        DO 70 L =1,NL
        LNKAFL(L,MON)=LNKAFL(L,MON)+LNKFLO(L,MON)/NYEAR
        IF(LNKFLO(L,MON).GT.LNKMX(L,MON)) LNKMX(L,MON)=LNKFLO(L,MON)
70      CONTINUE
        DO 71 I=1,2
71      IAVEP(I,MON)=(ICAP(I,MON,6)+IAVEP(I,MON))/NYEAR
        NDS=NJ-NRES
        IF(NDS.EQ.0) GO TO 76
        DO 74 J = 1,NDS
        JN=J+NRES
        ICAP(JN,MON,2)=UREG(JN)
        ICAP(JN,MON,4)=USE(JN)
        ICAP(JN,MON,8)=ISHTM(JN,MON)
74      CONTINUE
76      CONTINUE
        DO 82 JN= 1,NJ
        TOTLS(JN,IY,13)=TOTLS(JN,IY,13)+DEMON(JN,MON)
        IF(MON.EQ.1)TOTLS(JN,IY,1)=START(JN)
        IF(MON.EQ.36)TOTLS(JN,IY,12)=STEND(JN)
        DO 82 I = 2,11
        TOTLS(JN,IY,I)=TOTLS(JN,IY,I)+ICAP(JN,MON,I)
82      CONTINUE
200     CONTINUE
        KEY=1
        CALL OUT2(IY)
300     CONTINUE
        RETURN
450     WRITE(KOUT,452)IY,MON,(L,NF(L),NT(L),LO(L),HI(L),FLOW(L),COST(L)
        1,L=1,NARC)
452     FORMAT(//////20X,'SOLUTION INFEASIBLE  YEAR',I3,' MONTH',I3//
        1'    LINK  FROM   TO    LO     HI      FLOW       COST' //
        2(3I5,4I10))
        RETURN
        END
```

```
      SUBROUTINE CARDS
      INTEGER RCAP,RMIN,FSTART,ACTAB,DEM,DEMR,
      1OPRP,SP,CMAX,CMIN
      COMMON /CONTRL/KIN,KOUT,KAPE1
      COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
      1NR
      COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
      1,NPRES(20),ACTAB(20,20,2),OPRR(3,20,36),OPRP(3,10),SP(20),DEM
      2(20),DEMR(20,3),DEMD(20,36),EVAP(20,36),U(20,36),DIMP(36),IMPRT,
      3ARF(15,36),AREG(36),RVCAP(20,36),MWP(20)
      COMMON/LINK/LNODE(200,2),CMAX(200),CMIN(200)
      COMMON/CONFAC/AVRGLO,AVRGHI,CONFLO,CONDEM,CONINF,
      1CPCT,NSRS,LRULE,JESVOL(20)
      COMMON/POW/ NROW(5),NCOL(5),F(5,25,25),EATAB(5,18,2),TWTAB(5,18,2
      1PLTAB(5,18,2),
      1HNET(36,5),FDIS(36,5),CELE(36,5),CTWL(36,5),ROW(5,25),
      1COL(5,25),AREA(36,5),HYDL(20)
      COMMON/RFAC/NODMP(15),NADMP(15,15),EXOUT(15,36),FAC(15,36),IAVEP
      1(15,37),NRF,EXINF(15,36),ST(15,36)
      DATA TAPE/4HTAPE/
      DO 4 J=1,NJ
      DO 4 K=1,3
      DEMR(J,K)=99
      OPRP(K,J)=99
4     CONTINUE
      READ(KIN,11,END=22)(TITLE(I),I=1,20)
11    FORMAT(20A4)
      READ(KIN,12)NJ,NRES,NL,NR,NYEAR,ND,NS,IYEAR,
      1IMP,NRF
12    FORMAT(10X,10I5)
      IFROM=IFRM
      NC=NL-NR
      KCRD=0
      IF(TAPE1-TAPE)26,28,26
26    KCRD=1
28    CONTINUE
      DO 105 I=1,NJ
105   READ(KIN,13) J,(RNAME(J,K),K=1,2),
      1RCAP(J),RMIN(J),FSTART(J),IVCAP(J),NPRES(J),MWP(J)
13    FORMAT(T11,I5,T1,2A4,T16,3I10,2I2,I5)
      READ(KIN,18) (SP(I),I=1,NS)
      DO 100 J=1,NRES
      IF(IVCAP(J).LT.1) GO TO 100
      READ(KIN,123) (RVCAP(J,K),K=1,36)
100   CONTINUE
18    FORMAT(10X,12I5)
      IF(NRES.EQ.0) GO TO 2
      DO 107 I=1,NRES
107   READ(KIN,15) J,((ACTAB(J,K,L),L=1,2),K=1,18)
2     CONTINUE
```

```
15     FORMAT(10X,I5,6I10/(15X,6I10))
       DO 108 I=1,ND
108    READ(KIN,16) J,DEM(J),(DEMR(J,K),K=1,3),(DEMD(J,K),K=1,36)
16     FORMAT(10X,I3,I8,3I3,12F4.0/(30X,12F4.0))
       READ(KIN,17) IMP,IMPRT,(DIMP(I),I=1,36)
17     FORMAT(10X,I5,I10,5X,12F4.0/(30X,12F4.0))
       READ(KIN,14) NSRS,(JESVOL(I),I=1,NSRS)
14     FORMAT(10X,14I5)
       READ(KIN,23) AVRGLO,AVRGHI
23     FORMAT(10X,2F10.1)
       READ(KIN,24) CONFLO,CONINF,CONDEM
24     FORMAT(10X,3F10.3)
       IF(CONINF.LE.0.0) CONINF=1.0
       IF(CONDEM.LE.0.0) CONDEM=1.0
       IF(CONFLO.LE.0.0) CONFLO=1.0
       DO 19 K=1,NRES
       DO 19 L=1,3
19     READ(KIN,109)J,OPRP(L,J),(OPRR(L,J,I),I=1,36)
109    FORMAT(1X,2I2,12F5.2/(5X,12F5.2))
       READ(KIN,20)(L,(LNODE(L,I),I=1,2),CMAX(L),CMIN(L),K=1,NL)
20     FORMAT(10X,3I5,2I10)
C      POWER DATA
       DO 114 N=1,NRES
       IF(NPRES(N).LT.0) GO TO 114
50     READ(KIN,150) J,((EATAB(J,K,L),L=1,2),K=1,18)
55     READ(KIN,150) J,((TWTAB(J,K,L),L=1,2),K=1,18)
       READ(KIN,160)  HYDL(N)
160    FORMAT(1X,F3.0)
150    FORMAT(1X,I2,6F8.1/(3X,6F8.1))
       IF(NPRES(N).EQ.N) GO TO 114
       READ(KIN,200)  NROW(N),NCOL(N)
200    FORMAT(1X,4I2)
       READ(KIN,112) (ROW(N,L),L=1,NROW(N))
       DO 116  J=1,NCOL(N)
       READ(KIN,115)  COL(N,J),(F(N,I,J),I=1,NROW(N))
112    FORMAT(10X,8F10.3)
115    FORMAT(9F10.3)
116    CONTINUE
114    CONTINUE
C      READ RESERVOIR FACTOR DATA
       DO 121 I=1,NRF
121    READ(KIN,122) NODMP(I),(NADMP(I,J),J=1,NODMP(I))
122    FORMAT(2X,5I2)
       READ(KIN,123) ((EXINF(I,J),J=1,36),(EXOUT(I,J),J=1,36),I=1,NRF)
123    FORMAT(1X,12F9.0)
       READ(KIN,124) ((ARF(I,J),J=1,36),I=1,NRES)
124    FORMAT(1X,12F8.0)
       READ(KIN,123) ((ST(I,MON),MON=1,36),I=1,NRF)
       DO 125 I=1,NRF
       DO 125 J=1,36
```

```
125     PRINT 126,J,ARF(I,J),EXINF(I,J),EXOUT(I,J),ST(I,J)
126     FORMAT(5X,I2,4F12.0)
        RETURN
22      CALL EXIT
        RETURN
        END
```

```
      SUBROUTINE POW
C     THIS SUBROTNIE COMPUTES POWER BOTH BY CONVENTIONAL METHOD
C     AND POWER INTERPOLATION TECHNIQUE
      COMMON/POW/ NROW(5),NCOL(5),F(5,25,25),EATAB(5,18,2),TWTAB(5,18,2),
     1PLTAB(5,18,2),
     1HNET(36,5),FDIS(36,5),CELE(36,5),CTWL(36,5),ROW(5,25),
     1COL(5,25),AREA(36,5),HYDL(20)
      COMMON/DPL/DLX(50,5),DDLX(50,5),DLY(50,5),DDLY(50,5),AP(50,5),
     1AQ(50,5),POWR(50,5)
      COMMON/PRNT/ICAP(20,36,13),TOTLS(20,20,36)
      COMMON/PARM/NJ,NRES,NJUNC,NL,NC,NYEAR,ND,NS,IYEAR,IMP,TITLE(20),
     1NR
      COMMON/RESV/RNAME(20,2),RCAP(20),RMIN(20),FSTART(20),IVCAP(20)
     1,NPRES(20),ACTAB(10,20,2),OPRR(3,10,36),OPRP(3,10),SP(20),DEM
     2(20),DEMR(10,3),DEMD(20,36),EVAP(20,36),U(20,36),DIMP(36),IMPRT,
     3ARF(15,36),AREG(36),RVCAP(20,36),MWP(20)
      COMMON/CONFAC/AVRGLO,AVRGHI,CONFLO,CONDEM,CONINF,
     1CPCT,NSRS,LRULE,JESVOL(20)
      DIMENSION IFAC(36),AFM(36),AF(36)
      DATA IFAC/10,10,11,10,10,8,10,10,11,10,10,10,10,10,11,10,10,10
     1,10,10,11,10,10,11,10,10,10,10,10,11,10,10,10,10,10,11/
      AI=0.000001
      DO 50 N=1,NRES
      DO 50 MON=1,36
      FDIS(MON,N)=0.0
      HNET(MON,N)=0.0
      CELE(MON,N)=0.0
      CTWL(MON,N)=0.0
      POWR(MON,N)=0.0
      AREA(MON,N)=0.0
50    CONTINUE
      DO 100   N =1,NRES
      DO 150 MON=1,36
      FDIS(MON,N)=ICAP(N,MON,7)/(IFAC(MON)*CONFLO)
      AREA(MON,N)=ICAP(N,MON,5)
      CALL INPOL(AREA,CELE,EATAB)
      IF(FDIS(MON,N).LE.100.0) GO TO 150
      CALL INPOL(FDIS,CTWL,TWTAB)
      HNET(MON,N)=CELE(MON,N)-CTWL(MON,N)-HYDL(N)
150   CONTINUE
100   CONTINUE
      DO 750 MON=1,36
      DO 800 N=1,NRES
      IF(FDIS(MON,N).LE.100.0) GO TO 800
      IF(NPRES(N).LT.0) GO TO 800
      IF(NPRES(N).NE.N) GO TO 700
      QMAX=(MWP(I)*1000)/(0.08464*0.86*HNET(MON,N))
      IF(FDIS(MON,N).GE.QMAX) FDIS(MON,N)=QMAX
      POWR(MON,N)=(FDIS(MON,N)*HNET(MON,N)*0.86)/11800
      GO TO 800
```

```
700     DO 2 L=1,NCOL(N)
        IF(FDIS(MON,N).GT.COL(N,L)) GO TO 2
        NJC=L
        GO TO 3
2       CONTINUE
3       DO 4 K=1,NROW(N)
        IF(HNET(MON,N).GT.ROW(N,K)) GO TO 4
        NK=K
        GO TO 5
4       CONTINUE
5       NJ1=NJC-1
        NK1=NK-1
        DLX(MON,N)=FDIS(MON,N)-COL(N,NJ1)
        DDLX(MON,N)=COL(N,NJC)-COL(N,NJ1)
        AP(MON,N)=DLX(MON,N)/DDLX(MON,N)
        DLY(MON,N)=HNET(MON,N)-ROW(N,NK1)
        DDLY(MON,N)=ROW(N,NK)-ROW(N,NK1)
        AQ(MON,N)=DLY(MON,N)/DDLY(MON,N)
        POWR(MON,N)=((1.0-AP(MON,N))*(1.0-AQ(MON,N))*F(N,NK1,NJ1))+(
        1AP(MON,N)*(1.0-
        1AQ(MON,N))
        1*F(N,NK1,NJC))+(AQ(MON,N)*(1.0-AP(MON,N))*F(N,NK,NJ1))+
        1(AP(MON,N)*AQ(MON,N)*
        1F(N,NK,NJC))
800     CONTINUE
750     CONTINUE
        WRITE(3,760)
760     FORMAT(12X,'POWER GENERATION IN  THE  SYSTEM',/12X,'*******
        1*****************************',//)
        DO 200 J=1,36
200     AFM(J)=0.0
        DO 300 N=1,NRES
        IF(NPRES(N).LT.0) GO TO 300
        WRITE(3,310) N
310     FORMAT(/10X,'RESERVOIR  NO = ',I2/)
        WRITE(3,320)
320     FORMAT(5X,'PERIOD   R.LEVEL   TW.LEVEL   DISCHARGE   NET HEAD   POWER
        2 IN M.W'//)
        DO 500 J=1,36
        AFM(J)=AFM(J)+POWR(J,N)
        WRITE(3,400) J,CELE(J,N),CTWL(J,N),FDIS(J,N),HNET(J,N),POWR(J,N)
400     FORMAT(5X,I4,5F11.2)
500     CONTINUE
300     CONTINUE
        WRITE(3,250)
250     FORMAT(/5X,'SYSTEM TOTAL POWER GENERATED IN M.W'/)
        WRITE(3,275) (AFM(J),J=1,36)
275     FORMAT(5X,6F9.2)
        DO 280 MON=1,36
280     AF(MON)=AF(MON)+AFM(MON)
```

```
      PRINT 281, (AF(MON),MON=1,36)
281   FORMAT(1X,18F7.0)
      RETURN
      END
```

```
      SUBROUTINE INPOL(SX,SY,Z)
      DIMENSION SX(36,5),SY(36,5),Z(5,18,2)
      DO 11 K=1,36
      DO 10 J=1,2
      DO 5 I=1,18
      IF(SX(K,J)-Z(J,I,2)) 2,3,5
5     CONTINUE
      SY(K,J)=Z(J,I,1)
      GO TO 10
3     SY(K,J)=Z(J,I,1)
      GO TO 10
2     X1=Z(J,I,2)-Z(J,I-1,2)
      Y1=Z(J,I,1)-Z(J,I-1,1)
      X2=SX(K,J)-Z(J,I-1,2)
      X3=(X2/X1)*Y1
      SY(K,J)=Z(J,I-1,1)+X3
10    CONTINUE
11    CONTINUE
      RETURN
      END
```

2.5.2 Input specification

The input specification of the model on sequential basis is as given below:

1 Fortran logical unit card

	Variable	Format	Description
1.1	KIN	I 5	Logical unit for input file
1.2	KOUT	I 5	Logical unit for output file
1.3	KAPE 1	I 5	Logical unit for input tape

2 Title card

	Variable	Format	Description
	TITLE (I)	20A4	Title of the Problem

3 System detail card

	Variable	Format	Description
3.1	NJ	I 5	No. of Junctions in the system
3.2	NRES	I 5	No. of reservoirs
3.3	NL	I 5	No. of links
3.4	NR	I 5	No. of river reaches
3.5	NYEAR	I 5	No. of years to simulate
3.6	ND	I 5	No. of nodes in the system
3.7	NS	I 5	No. of spill reservoirs
3.8	IYEAR	I 5	Starting year of simulation
3.9	IMP	I 5	Node where import occurs
3.10	NRF	I 5	No. of reservoirs where R.F. used

4 Node card

	Variable	Format	Description
4.1	J	I 5	Node No.
4.2	RNAME	2A 4	Node name array
4.3	RCAP	I 10	Maximum capacity in volume

	Variable	Format	Description
4.4	RMIN	I 10	Minimum capacity to be maintained (dead storage)
4.5	FSTART	I 10	Starting storage
4.6	IVCAR	I 2	Variable capacity 0 = No. of variable capacity 1 = variable capacity to be used
4.7	NPRES	I 2	Power Reservoir Indicator If NPRES= - Ve No Power = 0 Power Table is given = NRES conventional method is used
4.8	MWP	I 5	Turbine capacity

Spill reservoir card

5.1	SP	2 I 2	List of Spill reservoirs Nos.

Variable Reservoir capacity card

Card will be there if IVCAP =0

6.1	RVCAP	12 F 9.0	Ten daily variable capacity

Area capacity table (for all the reservoirs)

7.1	J	I 5	Reservoir No.
7.2	ACTAB	18 I10	Area-capacity-for Reservoir

Demand and distribution card.(If annual demand and their distribution is given it will over ride the variable demand)

8.1	J	I 3	Demand node No.
8.2	DEM	I 8	Annual demand at node
8.3	DEMR	3I 3	Ranking of Nodes demands for system state

	Variable	Format	Description
8.4	DEMD	36 F4.0	Tendaily distribution of demand for periods

9 Import Card

9.1	IMP	I 5	Node No. where import occurs
9.2	IMPRT	I 10	Annual import amount
9.3	DIMP	36 F4.0	Tendaily import distribution for

10 Subsystem of reservoirs card

10.1	NSRS	I 5	No. of reservoirs in subsystem
10.2	JESVOL	14 I 5	List of reservoirs in subsystem

11 Status card

11.1	AVRGLO	F 10.1	Lower bound for system average storage
11.2	AVRGHI	F 10.1	Upper bound for Average storage

12 Multiplication factor card

12.1	CONFLO	F 10.3	Conversion factor to convert flow into 10 daily volume unit
12.2	CONINF	F 10.3	Conversion factor to convert read in flows to system unit
12.3	CONDEM	F 10.3	Conversion factor to convert read in demands in system units

13 Operation rule card (to be repeated for NRS reservoirs)

13.1	J	I 5	Reservoir No.
13.2	OPRP	I 5	Ranking of reservoir storage for system states
13.3	OPRR	36 F 4.3	Tendaily operation rule for system states

	Variable	Format	Description
14	Link capacity card (to be repeated for NL links)		
14.1	L	I 5	Link No.
14.2	LNODE	2I 5	Nodes at end of link
14.3	CMAX	I 10	Maximum capacity of link
14.4	CMIN	I 10	Minimum capacity of link

POWER CARDS (to be furnished for Reservoirs if NPRES equals to one or more

15	Elevation area,Table card		
15.1	J	I 2	Reservoir No.
15.2	EATAN	F 8.1	Elevation area table
16	Tail water elevation-discharge table (only if NPRES equals to one or more)		
16.1	J	I 2	Node No.
16.2	TWTAB	18 F 8	Elevation-discharge-table
17	Hydraulic loss card (only if NPRES equals to one or more)		
17.1	HYDL	F 3.0	Hydraulic Loss in turbine head unit for J node
18	Power table card		
18.1	NROW	I 2	No. of rows in Power table for J node
18.2	NCOL	I 2	No. of columns in power table
19	Power table card		
19.1	ROW	8 F10.3	Heads
20	Power table card		
20.1	COL	F 10.3	Discharge
20.2	F	8 F 10.3	Power Produced

	Variable	Format	Description

Cards 15 to 20 are to be repeated for NRES times.

21 Reservoir factor card (to be repeated NRF times)

21.1	NODMP	I 2	No. of demand points controlled by reservoir(for R.F.)
21.2	NADMP	4 I 2	Names of demand points controlled by reservoir

22 Expected in flow and indent card - to be repeated NRF times)

22.1	EXINF	12F9.0	Expected cumulative inflow from June first - to be started from Jan. first
22.2	EXOUT	12F9.0	Reservoir indent-cumulative from June first - to be started from Jan. First

23 Average flow card - to be repeated NRES times

23.1	ARF	12F 8.0	Average inflow on a tendaily basis. To be started from Jan.first

24 Unit R.F.storage card - to be repeated NRES times

24.1	ST	12F9.0	Unit R.F.storage in volume unit for reservoirs and time periods from Jan.

25 Variable Flow card (to be repeated for NYEAR and NJ times)

25.1		12F8.0	Inflow for Nodes

26 Variable demand card(to be repeated for NYEAR and NJ times)

26.1	D	12F8.0	Demand for Nodes

27 Evaporation card(to be rpeeated for NYEAR and NRES times)

27.1	E	12F8.3	Evaporation for Reservoir. Evaporation data should be in such a way that evaporation multiplied by Area unit should yield in the capacity unit.

2.5.2 Output description

The output provides the following information for the analysis of the operator.

1) Annual report

This gives a detailed information of the nodes like releases made, prevailing reservoir factor and power produced separately. Release columns gives detail of the volume of water that has come into the reservoir including upstream spill, the flow out of the reservoir to meet the down stream demands, the spill that was lost from the system, the volume of water that the reservoir lost due to evaporation, the surface area of water spread, the volume that was diverted into and from nodes and the initial and final storage capacity on ten-daily basis provides an idea to the planner the performances of different elements of the system for the operation policy. Here 'diverted into' means the surplus which could not be negotiated through the rivers section due to capacity restriction and hence diverted into a canal reach. As mentioned earlier flow through river section is set less costlier than the canal section for the minimization objective function used here. Thus the excess inflow which could not be stored in a node or negotiated through the river section will be diverted through a canal and used in the down stream storage nodes or demand points rather than allowing it to go as a loss to the system as a final option. The negative flow under the head ' unregulated inflow' shows the loss in the link just upstream of it.

The upper limit of reservoir factor(R.F.) is set to unity as more than the planned releases or maximum demand will not be released just because of the exceptionally sound storage position in the reservoir. Shortage is the difference between the planned releases (user supplied demand as per unit reservoir factor) and the actual releases made. Thus under the head ' demand', demand decided as per rulling R.F. appears and that under ' Act.demand' the unit R.F. demand (user supplied).

The annual power computation report prints out the reservoir level, tail water level net head, the flow routed through the turbine and the power produced. Also it provides the total power generated in the system.

2) Simulation period summary

At the end of the annual report, for the entire simulation period this summary is printed out. This gives details on the annual and nodal basis of inflow, the system loss, the average reservoir loss or gain due to evaporation or precipitation, the shortages and demands. Also this prints out the average and maximum flow in all the river and canal reaches of the system. This section focusses on the over all behaviour of the system.

2.5.3 Hypothetical Problem

Figure 2 shows the system configuration of the example problem. The example problem given here consists of seven nodes, out of these node number one and two are reservoirs

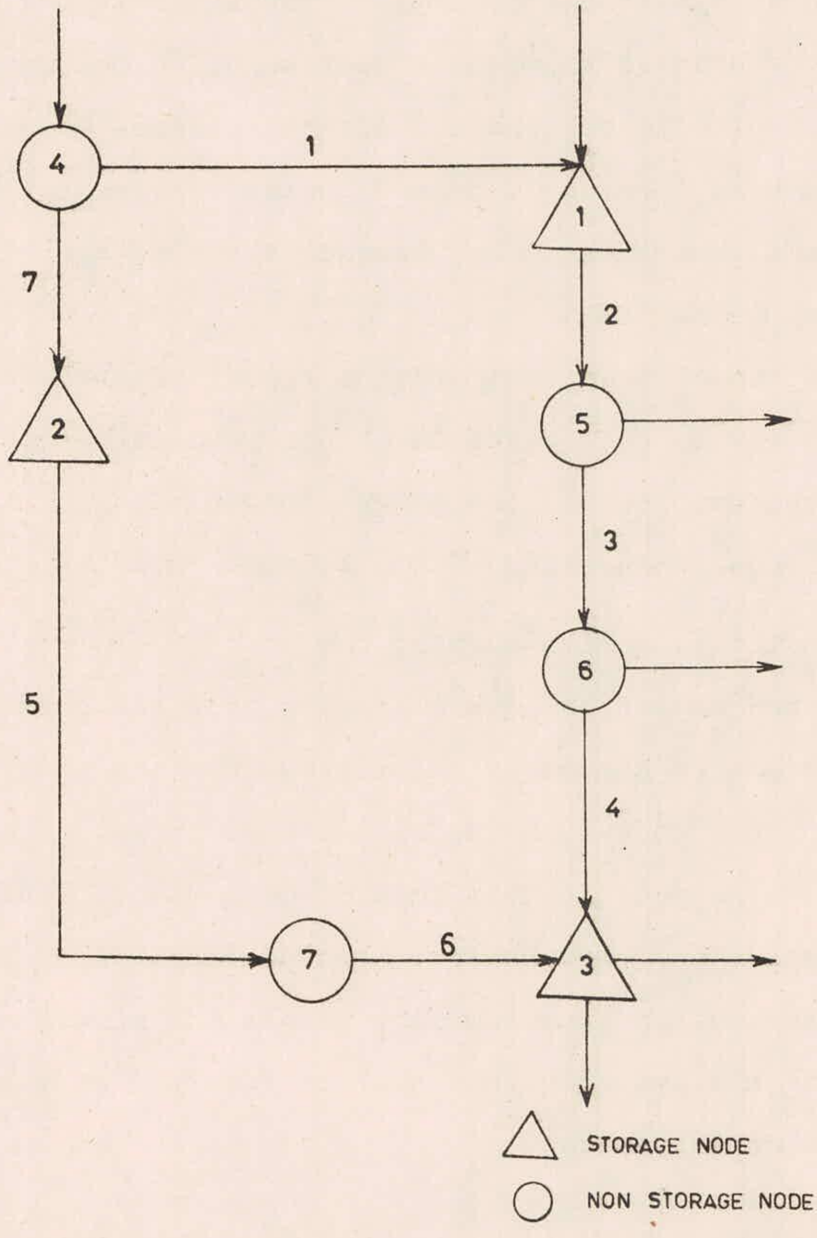

FIGURE 2 - SYSTEM CONFIGURATION OF EXAMPLE PROBLEM

with large storage capacity. Node number 3 is also considered as a reservoir even though it does not have any storage capacity since as per the modal structure detailed printouts are available only at storage nodes and system loss had to be analysed at a single point. As reservoir No.1 can serve the irrigation requirement of the entire system including that of the command area of reservoir No.2 the link connecting nodes 4 and 1 with a limited capacity of 75000 cusecs is considered to be a river and the one connects nodes 4 and 2 is assumed as a canal. It is so since as per the model structure of the minimization problem the cost of flow through the canal is more than that of the river reach and whenever flow available, only the excess of the maximum capacity of the river reach will be diverted through the canal.

The lower and upper boundaries of the nodes and links area as given in the out put shown here. Reservoirs 1 and 2 have turbine capacities of 1035 MW and 360 MW respectively and their power generation for different heads and discharges are calibrated. Their respective power tables are supplied. Demand of Node No. 6 is controlled by reservoir No. 1 and that of node No. 3 is controlled by reservoir No.2.

The cumulative available flow and indent are given in the volume units. The average flow is the tendaily average summed up for ten days.

The hydrologic status are described by taking reservoirs no. 1 and 2 as subsystems. The lower and upper limits of average are 70% full and 100% full of unit R.F. capacity.

The operation rule is fixed in such a way that higher priorities are enjoyed by demand requirements than storing at the reservoirs. Release priorities between reservoir - 1 and reservoir - 2 to meet the demand are as follows :

a) Meet the demand of reservoir 3 through reservoir as long as water is available above dead storage level of reservoir - 2

b) When little or no storage is available above the dead storage level of reservoir-make additional releases from reservoir - 1 to meet the demand of reservoir - 3.

This is so because water stored in reservoir No. 1 can be used for the entire system and head available at reservoir No. 2 is less than that of reservoir No. 1 for power generation.

The desired storages are given as the percentage of the unit reservoir factor storage at the individual reservoirs.

2.5.4 Hypothetical Problem input and output

INPUT

```
                1    3   20
                                SYSTEM OPERATION STUDY  BY  N , I , H ,
                7    3    7     6    2    7     1 1964          2
RESV.1          1   7424550    1619560    4100000 0 0 1035
RESV.2          2   6955000    1044000    5350000 0 0  360
RESV.3          3                                   -1
NODE.4          4                    0              -1
NODE.5          5                    0              -1
NODE.6          6                    0              -1
NODE.7          7                    0              -1
                3
                1      9550     990300       9830    1178950     11750    1489720
                      14890    1851110      15970    2131130     18820    2456400
                      20870    2830450      22000    3042030     24250    3480030
                      26710    3985600      29440    4552080     30830    4839600
                      32415    5157120      34000    5475420     35525    5839700
                      37050    6204570      40150    6999550     43400    7824550
                2        93        486        494       4864      3312      64045
                       5363     132955       7795     242400     10024     387515
                      12740     573976      15845     807458     19965    1101743
                      24914    1469801      30973    1927847     36466    2480745
                      41800    3122821      47654    3856505     53326    4685042
                      58016    5598702      62910    6590190     67244    7657884
                3


              1      0 35 35 35

              2      0 20 20 20

              3      0 25 25 25

              4      0 20 20 20

              5      0 10 10 10

              6      0 13 13 13

              7      0 30 30 30
```

```
          2    1    2
               0.7       1.00
          1.9835     1.9835     1.9835
130 1.11 1.14 1.18 0.99 1.06 1.12 0.91 1.00 1.10 1.09 1.11 1.11
    0.92 1.02 1.13 4.32 4.42 3.57 3.87 2.58 1.81 2.11 1.63 1.31
    1.24 1.17 1.14 1.06 1.10 1.16 1.09 1.16 1.25 1.20 1.25 1.31
130 0.99 1.02 1.05 0.90 0.96 1.02 0.87 0.95 1.05 1.00 1.03 1.03
    0.95 1.04 1.16 4.32 4.42 3.57 3.13 2.09 1.46 1.55 1.20 0.96
    0.90 0.86 0.83 0.82 0.84 0.89 0.90 0.96 1.03 1.01 1.05 1.10
130 1.17 1.20 1.24 1.06 1.13 1.20 1.02 1.11 1.22 1.24 1.27 1.27
    1.06 1.17 1.30 4.32 4.42 3.57 4.11 2.74 1.92 2.27 1.76 1.42
    1.26 1.20 1.16 1.08 1.11 1.17 1.10 1.17 1.26 1.23 1.29 1.35
250 1.25 1.32 1.39 1.29 1.35 1.43 1.04 1.16 1.32 1.24 1.27 1.31
    1.30 1.36 1.42 3.58 6.8418.9916.96 4.93 2.28 2.76 1.81 1.40
    1.35 1.28 1.24 1.05 1.11 1.19 1.06 1.13 1.20 1.08 1.13 1.19
250 0.40 0.42 0.44 0.46 0.48 0.51 0.50 0.56 0.63 0.74 0.76 0.78
    0.82 0.86 0.89 3.58 6.8418.9911.32 3.29 1.52 1.04 0.68 0.53
    0.38 0.35 0.34 0.35 0.37 0.40 0.31 0.33 0.35 0.36 0.38 0.40
250 1.30 1.37 1.45 1.39 1.46 1.55 1.19 1.33 1.51 1.51 1.55 1.59
    1.62 1.69 1.77 3.58 6.8418.9918.27 5.31 2.46 2.80 1.84 1.42
    1.35 1.28 1.24 1.06 1.12 1.20 1.09 1.16 1.23 1.13 1.18 1.24
360


360


360


          1    4    1     75000
          2    1    5   1000000     000000
          3    5    6   1000000     000000
          4    6    3   1000000
          5    2    7   1000000
          6    7    3   1000000
          7    4    2   1000000
1  1400.0  9550.0  1420.0  9830.0  1450.0 11750.0
   1480.0 14890.0  1500.0 15970.0  1540.0 20870.0
   1550.0 22000.0  1560.0 23130.0  1570.0 24250.0
   1590.0 26710.0. 1610.0 29440.0  1620.0 30830.0
   1630.0 32415.0  1640.0 34000.0  1650.0 35525.0
   1660.0 37050.0  1680.0 40150.0  1700.0 43400.0
1  1167.0  5000.0  1167.5 11650.0  1168.0 13150.0
   1168.5 14500.0  1169.0 16100.0  1169.5 17550.0
   1170.0 19000.0  1170.5 20500.0  1171.0 22000.0
   1171.5 23500.0  1172.0 24600.0  1172.0 50000.0
```

1172.0125000.0

4.0
822

	268.000	320.000	360.000	400.000	440.000	480.000	500.000	520.000
5000.000	200.000	200.000	200.000	200.000	200.000	200.000	200.000	200.000
7500.000	200.000	200.000	206.300	226.800	244.000	250.000	265.400	265.4
9025.000	200.000	219.700	241.400	274.600	300.000	310.000	326.100	326.1
9750.000	200.000	240.400	266.600	300.000	311.200	336.600	347.800	347.800
10450.000	209.300	258.000	300.000	319.600	344.300	359.600	376.600	376.600
12351.000	296.700	300.000	336.550	375.600	406.500	429.900	445.000	445.000
14450.000	300.000	349.700	400.000	442.400	469.500	500.900	525.800	525.800
16860.000	350.000	415.500	464.620	515.170	558.400	590.600	609.300	609.300
18294.000	376.600	450.000	515.000	556.900	607.000	640.600	654.800	654.800
19740.000	422.400	488.400	550.000	606.200	648.400	694.000	718.700	718.700
21440.000	456.200	523.200	593.900	650.000	655.400	749.200	781.600	781.600
22600.000	473.000	544.500	626.000	692.000	750.000	797.000	822.400	822.400
24012.000	493.400	581.600	669.300	731.100	792.800	850.000	869.400	869.400
25075.000	511.300	610.500	704.000	761.200	829.200	878.900	900.000	900.000
26973.000	596.700	656.600	797.400	824.300	883.600	950.000	979.600	979.600
28925.000	599.000	699.800	799.750	891.900	950.000	1024.400	1035.000	1035.000
30580.000	600.000	735.400	850.000	930.400	1010.200	1035.000	1035.000	1035.000
32823.000	600.000	800.000	911.900	999.200	1035.000	1035.000	1035.000	1035.000
34187.000	600.000	829.600	964.900	1035.000	1035.000	1035.000	1035.000	1035.000
35062.000	600.000	830.000	950.000	1035.000	1035.000	1035.000	1035.000	1035.000
36150.000	600.000	830.000	1000.000	1035.000	1035.000	1035.000	1035.000	1035.000
236150.000	600.000	830.000	1000.000	1035.000	1035.000	1035.000	1035.000	1035.000

2	1115.5	93.4	1148.3	494.7	1164.7	3311.1
	1181.0	5362.7	1197.5	7793.4	1213.9	10023.7
	1230.3	12740.0	1246.7	15845.3	1263.1	19965.4
	1279.5	24914.5	1295.9	30975.5	1312.3	36468.0
	1328.7	41800.1	1345.1	47654.0	1361.5	47654.0
	1377.9	58015.8	1394.3	62910.8	1410.7	67246.6
2	1085.0	100.0	1085.5	4000.0	1086.0	5200.0
	1086.5	6500.0	1087.0	7700.0	1087.5	8900.0
	1088.0	10200.0	1088.5	11400.0	1089.0	12600.0
	1089.5	13900.0	1090.0	15100.0	1090.5	16300.0
	1091.0	17600.0	1091.5	18800.0	1092.0	20000.0
	1092.5	21300.0	1093.0	22500.0	1093.0122500.0	

4.0
824

	156.000	164.000	196.850	215.000	225.000	262.500	290.000	312.000
100.000	1.000	1.000	1.000	1.000	1.000	1.000	45.000	46.500
1766.000	1.000	1.000	1.000	1.000	1.000	44.300	47.500	51.500
1989.000	1.000	1.000	1.000	43.000	45.000	52.500	56.280	60.000
2119.000	1.000	1.000	43.750	46.250	47.500	56.250	60.000	63.850
2566.000	1.000	43.750	53.600	57.000	60.000	70.000	75.000	78.750
2707.000	43.250	46.500	56.500	61.000	64.000	74.600	80.000	83.700
2790.000	44.300	48.000	59.000	63.000	66.500	76.250	82.500	86.200
2899.000	46.000	50.500	62.000	66.500	72.400	80.040	86.200	86.200

3119.000	49.000	54.000	66.000	72.500	75.000	86.200	86.200	86.200
3496.000	55.000	61.500	74.400	81.500	85.000	86.200	86.200	86.200
3534.000	55.000	61.500	75.800	82.000	86.200	86.200	86.200	86.200
3649.000	55.000	62.500	77.500	84.000	86.200	86.200	86.200	86.200
3767.000	55.000	62.500	79.200	86.200	86.200	86.200	86.200	86.200
3920.000	55.000	62.500	82.500	86.200	86.200	86.200	86.200	86.200
16242.000	259.500	279.000	339.000	360.000	360.000	360.000	360.000	360.000
16740.000	265.800	288.000	354.000	360.000	366.000	360.000	360.000	360.000
17394.000	276.000	303.000	360.000	360.000	360.000	360.000	360.000	360.000
18714.000	294.000	324.000	360.000	360.000	360.000	360.000	360.000	360.000
20976.000	330.000	360.000	360.000	360.000	360.000	360.000	360.000	360.000
21204.000	330.000	360.000	360.000	360.000	360.000	360.000	360.000	360.000
21894.000	330.000	360.000	360.000	360.000	360.000	360.000	360.000	360.000
22602.000	330.000	360.000	360.000	360.000	360.000	360.000	360.000	360.000
23520.000	330.000	360.000	360.000	360.000	360.000	360.000	360.000	360.000
223520.000	330.000	360.000	360.000	360.000	360.000	360.000	360.000	360.000

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28225.	18908.	13001.	27583.	35714.	80746.	53699.	355417.	224503.	341535.	147804.	75300.
59990.	62827.	37927.	29165.	23049.	26643.	19730.	16721.	21137.	15235.	19595.	34666.
21621.	17127.	31397.	49824.	30379.	20402.	32346.	31842.	77222.	52173.	47029.	33444.
38872.	28895.	36922.	36072.	14616.	61077.	175312.	316351.	451657.	204991.	249279.	177639.
60791.	46520.	49222.	36772.	28430.	23198.	38908.	23450.	24056.	20570.	16822.	14662.
-21603.	-521.	-11191.	-9669.	-10660.	-2885.	-10242.	-10004.	-794.	-5159.	-4406.	-5263.
-6591.	-3107.	-4993.	-9380.	-8115.	-17103.	-17271.	12013.	73280.	9220.	56549.	11289.
-18973.	-5025.	5221.	-8830.	-11387.	-3337.	-2185.	392.	-11325.	-11777.	3531.	-4925.
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-21192.	-362.	-14689.	4941.	795.	-317.	-5727.	-3533.	-4638.	-15656.	4198.	19815.
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40802.	32385.	10017.	21699.	24041.	18181.	11187.	13365.	20558.	47723.	45479.	64902.
39773.	41053.	51251.	34463.	37069.	29922.	8622.	20051.	50184.	60682.	28136.	117759.
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12632.	-711.	-3934.	11737.	25237.	53636.	57376.	222048.	119486.	130673.	82234.	31402.
15669.	14413.	2143.	5907.	-2050.	-2619.	410.	8062.	8747.	29576.	13328.	23619.
23562.	16115.	23585.	28684.	19041.	12858.	1346.	18006.	41091.	31519.	15769.	34011.
27620.	15582.	12446.	14661.	-510.	27204.	41718.	50228.	79140.	98703.	82768.	50795.
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205220.	215620.	237292.	211720.	201200.	147664.	151280.	151520.	166639.	151280.	151200.	151490.

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139330.	152670.	167530.	170330.	183300.	207889.	225850.	210490.	212070.	208660.	160920.	215127.
205220.	215620.	237292.	211720.	201200.	147664.	151280.	151520.	166639.	151280.	151200.	151490.
149960.	149510.	167937.	154020.	141410.	150300.	140990.	133070.	161018.	134330.	115960.	133969.
139330.	152670.	167530.	170330.	183300.	207889.	225850.	210490.	212070.	208660.	160920.	215127.
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106400.	120600.	125710.	110290.	102365.	99610.	103365.	105545.	94680.	86385.	96150.	62565.
65490.	101300.	101343.	71980.	74855.	41710.	76863.	62630.	70050.	104540.	105180.	87550.
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0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.058	0.058	0.058	0.080	0.080	0.080	0.135	0.135	0.135	0.189	0.189	0.189
0.217	0.217	0.217	0.147	0.147	0.147	0.119	0.119	0.119	0.104	0.104	0.104
0.105	0.105	0.105	0.107	0.107	0.107	0.066	0.066	0.066	0.054	0.054	0.054
0.058	0.058	0.058	0.080	0.080	0.080	0.135	0.135	0.135	0.189	0.189	0.189
0.217	0.217	0.217	0.147	0.147	0.147	0.119	0.119	0.119	0.104	0.104	0.104
0.105	0.105	0.105	0.107	0.107	0.107	0.066	0.066	0.066	0.054	0.054	0.054
0.058	0.058	0.058	0.080	0.080	0.080	0.135	0.135	0.135	0.189	0.189	0.189
0.217	0.217	0.217	0.147	0.147	0.147	0.119	0.119	0.119	0.104	0.104	0.104
0.105	0.105	0.105	0.107	0.107	0.107	0.066	0.066	0.066	0.054	0.054	0.054
0.058	0.058	0.058	0.080	0.080	0.080	0.135	0.135	0.135	0.189	0.189	0.189
0.217	0.217	0.217	0.147	0.147	0.147	0.119	0.119	0.119	0.104	0.104	0.104
0.105	0.105	0.105	0.107	0.107	0.107	0.066	0.066	0.066	0.054	0.054	0.054
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

RIVER BASIN SIMULATION PROGRAMME . *** NATIONAL INSTITUE OF HYDROLOGY ***

SYSTEM OPERATION STUDY BY N . I . H .

NUMBER OF NODES =	7	NUMBER OF RESERVOIRS =	3
NUMBER OF LINKS =	7	NUMBER OF RIVER REACHES =	6
CALENDAR YEAR OPERATION STARTS =	1964	NUMBER OF YEARS TO SIMULATE =	2
NUMBER OF DEMAND NODES =	7	NUMBER OF SPILL NODES =	1
NO OF RESERVOIRS WHERE R.F USED=	2	IMPORT NODE =	0

NODE NO.	NODE NAME	--------- CAPACITIES ---------			YEARLY	TURBINE
		MAXIMUM	MINIM	STARTING	DEMAND	CAPACITY IN M.W
1	RESV.1	7424550	1619560	4100000	0	1035
2	RESV.2	6955000	1044000	5350000	0	360
3	RESV.3	0	0	0		0
4	NODE.4	0	0	0	0	0
5	NODE.5	0	0	0	0	0
6	NODE.6	0	0	0	0	0
7	NODE.7	0	0	0	0	0

SYSTEM CONFIGURATION

LINK NO.	FROM NODE	TO NODE	MAX. CAPACITY	MIN. CAPACITY
1	4	1	75000	0
2	1	5	1000000	0
3	5	6	1000000	0
4	6	3	1000000	0
5	2	7	1000000	0
6	7	3	1000000	0
7	4	2	1000000	0

LIST OF SPILL RESERVOIRS - 3

YEARLY IMPORT QUANTITY = 10

10 DAILY IMPORT DISTRIBUTION -

0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00

SUB-SYSTEM OF RESERVOIRS 1 2

AVERAGE DEFINED AS BETWEEN 0.70 AND 1.00 FRACTION FULL OF SUBSYSTEM

FACTORS

MULTIPLY LINK CAPACITIES BY 1.984

MULTIPLY INFLOWS BY 1.98

MULTIPLY DEMANDS BY 1.98

10 DAILY DEMAND DISTRIBUTION
10 DAILY PERIODS

NODE NO.																			* RANK * AVG	DRY	WET
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35	35	35
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20	20	20
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25	25	25
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20	20	20
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10	10	10
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13	13	13
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30	30	30

DESIRED 10 DAILY STORAGE LEVEL (PERCENT FULL)

RES NO.																				
1	AVRG	1.11	1.14	1.18	0.99	1.06	1.12	0.91	1.00	1.10	1.09	1.11	1.11	0.92	1.02	1.13	4.32	4.42	3.57	
		3.87	2.58	1.81	2.11	1.63	1.31	1.24	1.17	1.14	1.06	1.10	1.16	1.09	1.16	1.25	1.20	1.25	1.31	30
	DRY	0.99	1.02	1.05	0.90	0.96	1.02	0.87	0.95	1.05	1.00	1.03	1.03	0.95	1.04	1.16	4.32	4.42	3.57	
		3.13	2.09	1.46	1.55	1.20	0.96	0.90	0.86	0.83	0.82	0.84	0.89	0.90	0.96	1.03	1.01	1.05	1.10	30
	WET	1.17	1.20	1.24	1.06	1.13	1.20	1.02	1.11	1.22	1.24	1.27	1.27	1.06	1.17	1.30	4.32	4.42	3.57	
		4.11	2.74	1.92	2.27	1.76	1.42	1.76	1.20	1.16	1.08	1.11	1.17	1.10	1.17	1.26	1.23	1.29	1.35	30
2	AVRG	1.25	1.32	1.39	1.29	1.35	1.43	1.04	1.16	1.32	1.24	1.27	1.31	1.30	1.36	1.42	3.58	6.84	18.99	
		16.96	4.93	2.28	2.76	1.81	1.40	1.35	1.28	1.24	1.05	1.11	1.19	1.06	1.13	1.20	1.08	1.13	1.19	50
	DRY	0.40	0.42	0.44	0.46	0.48	0.51	0.50	0.56	0.63	0.74	0.76	0.78	0.82	0.86	0.89	3.58	6.84	18.99	
		11.32	3.29	1.52	1.04	0.68	0.53	0.38	0.35	0.34	0.35	0.37	0.40	0.31	0.33	0.35	0.36	0.38	0.40	50
	WET	1.30	1.37	1.45	1.39	1.46	1.55	1.19	1.33	1.51	1.51	1.55	1.59	1.62	1.69	1.77	3.58	6.84	18.99	
		18.27	5.31	2.46	2.80	1.84	1.42	1.35	1.28	1.24	1.06	1.12	1.20	1.09	1.16	1.23	1.13	1.18	1.24	50
3	AVRG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60
	DRY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60
	WET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60

RESERVOIRS AREA - CAPACITY TABLES

	RESERVOIR NO. 1		RESERVOIR NO. 2		RESERVOIR NO. 3		RESERVOIR NO.
1	9550	990300	93	486	0	0	
2	9830	1178950	494	4864	0	0	
3	11750	1489720	3312	64045	0	0	
4	14890	1851110	5363	132955	0	0	
5	15970	2131130	7795	242400	0	0	
6	18820	2456400	10024	387515	0	0	
7	20870	2830450	12740	573976	0	0	
8	22000	3042030	15845	807458	0	0	
9	24250	3480030	19965	1101743	0	0	
10	26710	3985600	24914	1469801	0	0	
11	29440	4552080	30973	1927847	0	0	
12	30830	4839600	36466	2480745	0	0	
13	32415	5157120	41800	3122821	0	0	
14	34000	5475420	47654	3856505	0	0	
15	35525	5839700	53326	4685042	0	0	
16	37050	6204570	58016	5598702	0	0	
17	40150	6999550	62910	6590190	0	0	
18	43400	7824550	67244	7657884	0	0	

ELEVATION AREA TABLE
****

RESERVOIR NO: 1

1400.0	9550.0	1420.0	9830.0	1450.0	11750.0
1480.0	14890.0	1500.0	15970.0	1540.0	20870.0
1550.0	22000.0	1560.0	23130.0	1570.0	24250.0
1590.0	26710.0	1610.0	29440.0	1620.0	30830.0
1630.0	32415.0	1640.0	34000.0	1650.0	35525.0
1660.0	37050.0	1680.0	40150.0	1700.0	43400.0

RESERVOIR NO: 2

1115.5	93.4	1148.3	494.7	1164.7	3311.1
1181.0	5362.7	1197.5	7793.4	1213.9	10023.7
1230.3	12740.0	1246.7	15845.3	1263.1	19965.4
1279.5	24914.5	1295.9	30975.5	1312.3	36468.0
1328.7	41800.1	1345.1	47654.0	1361.5	47654.0
1377.9	58015.8	1394.3	62910.8	1410.7	67246.6

TAIL WATER LEVEL DISCHARGE TABLE
****

RESERVOIR NO: 1

1167.0	5000.0	1167.5	11650.0	1168.0	13150.0
1168.5	14500.0	1169.0	16100.0	1169.5	17550.0
1170.0	19000.0	1170.5	20500.0	1171.0	22000.0
1171.5	23500.0	1172.0	24600.0	1172.0	50000.0
1172.0	125000.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0

RESERVOIR NO: 2

1085.0	100.0	1085.5	4000.0	1086.0	5200.0
1086.5	6500.0	1087.0	7700.0	1087.5	8900.0
1088.0	10200.0	1088.5	11400.0	1089.0	12500.0
1089.5	13900.0	1090.0	15100.0	1090.5	16300.0
1091.0	17600.0	1091.5	18800.0	1092.0	20000.0
1092.5	21300.0	1093.0	22500.0	1093.0	122500.0

HEAD-DISCHARGE POWER TABLE IN M.W FOR RESERVOIR: 1

DISCHARGE	268.00	320.00	360.00	400.00	HEAD 440.00	480.00	500.00	520.00
5000.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00
7500.00	200.00	200.00	206.30	226.80	244.00	250.00	265.40	265.40
9025.00	200.00	219.70	241.40	274.60	300.00	310.00	326.10	326.10
9750.00	200.00	240.40	266.60	300.00	311.20	336.60	347.80	347.80
10450.00	209.30	258.00	300.00	319.60	344.30	359.60	376.60	376.60
12351.00	296.70	300.00	336.55	375.60	406.50	429.90	445.00	445.00
14450.00	300.00	349.70	400.00	442.40	469.50	500.90	525.80	525.80
16860.00	350.00	415.50	464.62	515.17	558.40	590.60	609.30	609.30
18294.00	376.60	450.00	515.00	556.90	607.00	640.60	654.80	654.80
19740.00	422.40	488.40	550.00	606.20	648.40	694.00	718.70	718.70
21440.00	456.20	523.20	593.90	650.00	655.40	749.20	781.60	781.60
22600.00	473.00	544.50	626.00	692.00	750.00	797.00	822.40	822.40
24012.00	493.40	581.60	669.30	731.10	792.80	850.00	869.40	869.40
25075.00	511.30	610.50	704.00	761.20	829.20	878.90	900.00	900.00
26973.00	596.70	656.60	797.40	824.30	883.60	950.00	979.60	979.60
28925.00	599.00	699.80	799.75	891.90	950.00	1024.40	1035.00	1035.00
30580.00	600.00	735.40	850.00	930.40	1010.20	1035.00	1035.00	1035.00
32823.00	600.00	800.00	911.90	999.20	1035.00	1035.00	1035.00	1035.00
34187.00	600.00	829.60	964.90	1035.00	1035.00	1035.00	1035.00	1035.00
35062.00	600.00	830.00	950.00	1035.00	1035.00	1035.00	1035.00	1035.00
36150.00	600.00	830.00	1000.00	1035.00	1035.00	1035.00	1035.00	1035.00
236150.00	600.00	830.00	1000.00	1035.00	1035.00	1035.00	1035.00	1035.00

HEAD-DISCHARGE POWER TABLE IN M.W FOR RESERVOIR: 2

DISCHARGE	156.00	164.00	196.85	215.00	HEAD 225.00	262.50	290.00	312.00
100.00	1.00	1.00	1.00	1.00	1.00	1.00	45.00	46.50
1766.00	1.00	1.00	1.00	1.00	1.00	44.30	47.50	51.50
1989.00	1.00	1.00	1.00	43.00	45.00	52.50	56.28	60.00
2119.00	1.00	1.00	43.75	46.25	47.50	56.25	60.00	63.85
2566.00	1.00	43.75	53.60	57.00	60.00	70.00	75.00	78.75
2707.00	43.25	46.50	56.50	61.00	64.00	74.60	80.00	83.70
2790.00	44.30	48.00	59.00	63.00	66.50	76.25	82.50	86.20
2899.00	46.00	50.50	62.00	66.50	72.40	80.04	86.20	86.20
3119.00	49.00	54.00	66.00	72.50	75.00	86.20	86.20	86.20
3496.00	55.00	61.50	74.40	81.50	85.00	86.20	86.20	86.20
3534.00	55.00	61.50	75.80	82.00	86.20	86.20	86.20	86.20
3649.00	55.00	62.50	77.50	84.00	86.20	86.20	86.20	86.20
3767.00	55.00	62.50	79.20	86.20	86.20	86.20	86.20	86.20
3920.00	55.00	62.50	82.50	86.20	86.20	86.20	86.20	86.20
16242.00	259.50	279.00	339.00	360.00	360.00	360.00	360.00	360.00
16740.00	265.80	288.00	354.00	360.00	366.00	360.00	360.00	360.00
17394.00	276.00	303.00	360.00	360.00	360.00	360.00	360.00	360.00
18714.00	294.00	324.00	360.00	360.00	360.00	360.00	360.00	360.00
20976.00	330.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
21204.00	330.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
21894.00	330.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
22602.00	330.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
23520.00	330.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00
223520.00	330.00	360.00	360.00	360.00	360.00	360.00	360.00	360.00

CUMULATIVE INDENT ON RESERVOIR FROM JUNE 1 ST
****
(TABLE STARTS FROM JAN 1 ST)

RESERVOIR NO: 1

```
6715728.0 6395532.0 6075336.0 5723120.0 5298413.0 4873706.0 4533940.0 4053616.0 3573292.0 3044935.0 2710081.0 2375227.0
2040373.0 1382188.0  724003.019288390.018621656.017954922.017288188.016696609.016105030.015454293.014862714.014271135.0
13620398.012949301.012278204.011607107.010981293.010355479.0 9667083.0 9092463.0 8517843.0 7943223.0 7547257.0 7151291.0

                    RESERVOIR NO:   2

2867281.0 2690154.0 2513027.0 2318188.0 2124479.0 1930770.0 1775803.0 1479369.0 1182935.0  856858.0  735864.0  614870.0
 493876.0  334561.0  175246.0 8942402.0 8620936.0 8299510.0 7978064.0 7709101.0 7440138.0 7144279.0 6875316.0 6606353.0
6310494.0 6005154.0 5699814.0 5394474.0 5016379.0 4638284.0 4222380.0 3959368.0 3696356.0 3433344.0 3250743.0 3068142.0


            CUMULATIVE AVAILABLABLE INFLOW FROM JUNE 1 ST
            *****************************************
                 (TABLE STARTS FROM JAN 1 ST)

                    RESERVOIR NO:   1

4608500.0 4386152.0 4183347.0 3943008.0 3732517.0 3494322.0 3296942.0 3060453.0 2815035.0 2512561.0 2231890.0 1897028.0
1486491.0 1032067.0  569554.020317980.019665250.018861822.017824892.016695881.015406850.013904061.012386102.010807980.0
9418046.0 8435507.0 7571225.0 7013421.0 6585642.0 6268161.0 5975418.0 5730902.0 5506344.0 5293395.0 5080702.0 4861099.0

                    RESERVOIR NO:   2

1351316.0 1300334.0 1249281.0 1147992.0 1057039.0  985685.0  915279.0  812216.0  725595.0  610782.0  519638.0  437047.0
 345663.0  241440.0  130794.0 9722032.0 9526717.0 9293713.0 8878931.0 8260505.0 7421324.0 6349029.0 5120055.0 4029771.0
3184788.0 2621476.0 2205675.0 1980177.0 1845987.0 1764535.0 1686562.0 1628799.0 1577212.0 1524875.0 1467482.0 1418273.0


            AVERAGE FLOW INTO THE RESERVOIRS
            ********************************

                    RESERVOIR NO:   1

  64844.0   64097.0   72109.0   65318.0   67423.0   65924.0   79862.0   90692.0  110036.0  107521.0  129764.0  166537.0
 198405.0  207312.0  257058.0  304797.0  373721.0  475841.0  492285.0  543811.0  607795.0  588098.0  544122.0  493060.0
 366717.0  294212.0  216707.0  171411.0  130814.0  118519.0   99195.0   88604.0   83240.0   76103.0   70934.0   73730.0

                    RESERVOIR NO:   2

  17558.0   17716.0   28137.0   26920.0   29811.0   24049.0   32385.0   31575.0   38992.0   27274.0   27423.0   24917.0
  31227.0   37314.0   41927.0   82844.0   99473.0  160814.0  260378.0  344634.0  420096.0  521857.0  465210.0  340026.0
 237065.0  169248.0   90163.0   53171.0   34034.0   30740.0   22739.0   19174.0   20048.0   20483.0   18127.0   22900.0

             NORMAL STORAGE FOR UNIT R.F
             ***************************


                    RESERVOIR NO:   1

3726788.0 3628940.0 3511549.0 3399672.0 3185456.0 2998944.0 2856558.0 2612723.0 2377817.0 2151934.0 2097751.0 2097759.0
2173442.0 1969681.0 1774009.0  589970.0  575966.0  712660.0 1082856.0 1620289.0 2317740.0 3169793.0 4096172.0 5082715.0
5821912.0 6133354.0 6326539.0 6213246.0 6015211.0 5706878.0 5311225.0 4981121.0 4631059.0 4269388.0 4086115.0 3909752.0

                    RESERVOIR NO:   2

2559965.0 2433820.0 2307746.0 2214196.0 2111440.0 1989085.0 1904524.0 1711153.0 1501340.0 1290076.0 1260226.0 1221823.0
1192213.0 1137121.0 1088452.0  264370.0  138239.0   49797.0  143133.0  492596.0 1062814.0 1839190.0 2799261.0 3620582.0
4169706.0 4427678.0 4538139.0 4458297.0 4214392.0 3917749.0 3579818.0 3374569.0 3163144.0 2952469.0 2827261.0 2693869.0


                                   SYSTEM OPERATION STUDY  BY  N . I . H .

   SIMULATION YEAR  1     CALENDAR  YEAR 1964

                  RESERVOIR NO  1   RESV.1     MAX. CAPACITY 7424550  MIN. OPERATING POOL 1619560
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PERID	INITIAL SRORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
1	4100000	76642	33796	0	26929	0.06	1562	247937	0	0	0	0	3960939	4360342	1.000	0.
2	3960939	67954	30970	0	25949	0.06	1505	362169	0	0	0	0	3696189	4354728	1.000	0.
3	3696189	70779	35480	0	24635	0.06	1429	376920	0	0	0	0	3424099	4354321	1.000	0.
4	3424099	69739	31890	0	23317	0.08	1865	352858	0	0	0	0	3171005	3603652	1.000	0.
5	3171005	65812	31904	0	21997	0.08	1760	351491	0	0	0	0	2915470	3599565	0.997	0.
6	2915470	59713	32118	0	20868	0.08	1669	260270	0	0	0	0	2745362	3598733	0.983	0.
7	2745362	63650	41227	0	19737	0.14	2664	347900	0	0	0	0	2499675	2913689	0.975	0.
8	2499675	51789	39660	0	18276	0.14	2467	285905	0	0	0	0	2302752	2900123	0.972	0.
9	2302752	83739	58134	0	16614	0.14	2243	368983	0	0	0	0	2073399	2900937	0.979	0.
10	2073399	84873	71955	0	15296	0.19	2891	384224	0	0	0	0	1843112	2668398	0.974	0.
11	1843112	110639	89753	0	14042	0.19	2654	379368	0	0	0	0	1661482	2664144	0.906	0.
12	1661482	153582	113378	0	13151	0.19	2486	287779	0	0	0	0	1638177	2664154	0.816	0.
13	1638177	237781	129050	0	13057	0.22	2833	362631	0	0	0	0	1639544	2303849	0.738	0.
14	1639544	262714	126392	0	13105	0.22	2844	376686	0	0	0	0	1649120	2304527	0.761	0.
15	1649120	332579	144977	0	13018	0.22	2825	504294	0	0	0	0	1619557	2306212	0.828	0.
16	1619557	498711	148762	0	13059	0.15	1920	605677	0	0	0	0	1659433	2548671	1.000	0.
17	1659433	611850	148762	0	14188	0.15	2086	500487	0	0	0	0	1917472	2545770	1.000	0.
18	1917472	802186	148762	0	17041	0.15	2505	390549	0	0	0	0	2475366	2544196	1.000	0.
19	2475366	804924	148762	0	20462	0.12	2435	386645	0	0	0	0	3039972	4450539	1.000	0.
20	3039972	1083169	148762	0	24441	0.12	2909	247937	0	0	0	0	4021057	4439592	1.000	0.
21	4021057	961868	148762	0	28740	0.12	3420	339516	0	0	0	0	4788751	4450061	1.000	0.
22	4788751	989409	148762	0	32718	0.10	3403	247937	0	0	0	0	5675582	7195430	1.000	0.
23	5675582	576286	148762	0	35835	0.10	3727	247937	0	0	0	0	6148966	7209263	1.000	0.
24	6148966	541906	148762	0	37486	0.10	3899	351494	0	0	0	0	6484241	7217455	1.000	0.
25	6484241	375774	148762	0	38426	0.10	4035	378051	0	0	0	0	6626691	7335609	1.000	0.
26	6626691	280585	148762	0	38709	0.10	4064	422912	0	0	0	0	6629062	7360025	1.000	0.
27	6629062	209477	103879	0	38385	0.10	4030	477414	0	0	0	0	6460974	7338785	1.000	0.
28	6460974	184723	86288	0	37752	0.11	4039	423658	0	0	0	0	6304288	6710306	1.000	0.
29	6304288	132676	62997	0	37019	0.11	3961	403292	0	0	0	0	6092708	6676885	1.000	0.
30	6092708	122663	56896	0	36050	0.11	3857	434245	0	0	0	0	5834165	6677047	1.000	0.
31	5834165	114507	45112	0	34934	0.07	2306	430772	0	0	0	0	5560706	5842348	1.000	0.
32	5560706	114408	41435	0	33706	0.07	2225	430776	0	0	0	0	5283548	5827912	1.000	0.
33	5283548	111314	38267	0	32432	0.07	2141	394958	0	0	0	0	5036030	5835135	1.000	0.
34	5036030	103340	35835	0	31347	0.05	1693	324623	0	0	0	0	4848889	5251348	1.000	0.
35	4848889	86778	34147	0	30325	0.05	1638	348443	0	0	0	0	4619733	5271088	1.000	0.
36	4619733	114852	36718	0	29474	0.05	1592	272731	0	0	0	0	4496980	5121775	1.000	0.

YEAR TOTALS 10613391. 3188640. 0. 95582.13309469. 0. 0. 0. 0. 0.

RESERVOIR NO 2 RESV.2 MAX. CAPACITY 6955000 MIN. OPERATING POOL 1044000

PERID	INITIAL SRORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
1	5350000	58777	0	0	56054	0.06	3251	325650	0	0	0	0	5079876	3327955	1.000	0.
2	5079876	46826	0	0	54412	0.06	3156	413403	0	0	0	0	4710143	3334334	1.000	0.
3	4710143	42484	0	0	51998	0.06	3016	474312	0	0	0	0	4275299	3346232	1.000	0.
4	4275299	56593	0	0	49326	0.08	3946	405631	0	0	0	0	3922315	3077733	1.000	0.
5	3922315	38971	0	0	46780	0.08	3742	380176	0	0	0	0	3577368	3082703	1.000	0.
6	3577368	38335	0	0	44383	0.08	3551	299876	0	0	0	0	3312276	3083082	1.000	0.
7	3312276	69963	0	0	42350	0.14	5717	308894	0	0	0	0	3067628	2266384	1.000	0.
8	3067628	49230	0	0	40236	0.14	5432	315367	0	0	0	0	2796059	2275834	1.000	0.
9	2796059	41875	0	0	37894	0.14	5116	328562	0	0	0	0	2504256	2267024	1.000	0.
10	2504256	54560	0	0	35550	0.19	6719	282080	0	0	0	0	2270017	1948015	1.000	0.
11	2270017	34639	0	0	33178	0.19	6271	275090	0	0	0	0	2023295	1953350	1.000	0.
12	2023295	37071	0	0	30505	0.19	5766	274810	0	0	0	0	1779790	1942699	1.000	0.
13	1779790	55984	0	0	27496	0.22	5967	285463	0	0	0	0	1544344	1931385	1.000	0.
14	1544344	37504	0	0	24115	0.22	5233	304125	0	0	0	0	1272490	1921735	1.000	0.
15	1272490	25787	0	0	20739	0.22	4500	249783	0	0	0	0	1043994	1926560	1.000	0.
16	1043994	54710	0	0	19176	0.15	2819	100986	0	49098	0	0	1043997	1044000	1.000	0.
17	1043997	70838	0	0	19176	0.15	2819	167327	0	99308	0	0	1043997	1044000	1.000	0.
18	1043997	160159	0	0	20092	0.15	2954	225656	0	202317	0	0	1177863	1044000	1.000	0.
19	1177863	104511	0	0	21942	0.12	2611	200105	0	235487	0	0	1317145	2615040	1.000	0.

PERID	INITIAL STORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
20	1317145	704969	0	0	29194	0.12	3474	0	0	364127	0	0	2382767	2615685	1.000	0.
21	2382767	445301	0	0	38669	0.12	4602	0	0	300449	0	0	3123915	2614523	1.000	0.
22	3123915	677434	0	0	45996	0.10	4784	0	0	424679	0	0	4221244	5149732	1.000	0.
23	4221244	293169	0	0	51710	0.10	5378	0	0	162451	0	0	4671486	5150641	1.000	0.
24	4671486	149357	0	0	53491	0.10	5563	181051	0	127688	0	0	4761917	5141227	1.000	0.
25	4761917	118990	0	0	53378	0.10	5605	282914	0	44547	0	0	4636935	5629103	1.000	0.
26	4636935	124617	0	0	52494	0.10	5512	284199	0	12750	0	0	4484591	5667428	1.000	0.
27	4484591	75228	0	0	51123	0.10	5368	317690	0	0	0	0	4236761	5627293	1.000	0.
28	4236761	57848	0	0	49326	0.11	5278	329772	0	0	0	0	3959559	4725795	0.959	0.
29	3959559	45717	0	0	47117	0.11	5041	371757	0	0	0	0	3628478	4720119	0.949	0.
30	3628478	52846	0	0	44456	0.11	4757	398442	0	0	0	0	3278125	4701299	0.938	0.
31	3278125	39134	0	0	41485	0.07	2738	419484	0	0	0	0	2895037	3902002	0.929	0.
32	2895037	33166	0	0	38591	0.07	2547	350173	0	0	0	0	2575483	3914500	0.879	0.
33	2575483	41925	0	0	35736	0.07	2360	358879	0	0	0	0	2256169	3890667	0.841	0.
34	2256169	30218	0	0	32921	0.05	1778	294636	0	0	0	0	1989973	3336290	0.797	0.
35	1989973	38866	0	0	30603	0.05	1653	203533	0	0	0	0	1823653	3336168	0.742	0.
36	1823653	68760	0	0	28303	0.05	1528	263962	0	0	0	0	1626923	3205704	0.716	0.
YEAR TOTALS		4078362.	0.	0.				150552.	9673788.		0.2022901.	0.	0.			0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 1 CALENDAR YEAR 1964

RESERVOIR NO 3 RESV.3 MAX. CAPACITY 0 MIN. OPERATING POOL 0

PERID	INITIAL SRORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
1	0	-42849	449902	407053	0	0.00	0	0	0	0	0	0	0	0	0.000	407054.
2	0	-1033	428715	427682	0	0.00	0	0	0	0	0	0	0	0	0.000	427682.
3	0	-22197	492865	470668	0	0.00	0	0	0	0	0	0	0	0	0.000	470669.
4	0	-19178	439124	419946	0	0.00	0	0	0	0	0	0	0	0	0.000	419947.
5	0	-21144	420224	399080	0	0.00	0	0	0	0	0	0	0	0	0.000	399080.
6	0	-5722	298613	292891	0	0.00	0	0	0	0	0	0	0	0	0.000	292892.
7	0	-20315	320378	300063	0	0.00	0	0	0	0	0	0	0	0	0.000	300064.
8	0	-19842	320381	300539	0	0.00	0	0	0	0	0	0	0	0	0.000	300540.
9	0	-1574	332102	330528	0	0.00	0	0	0	0	0	0	0	0	0.000	330528.
10	0	-10232	310295	300063	0	0.00	0	0	0	0	0	0	0	0	0.000	300064.
11	0	-8739	308644	299905	0	0.00	0	0	0	0	0	0	0	0	0.000	299905.
12	0	-10439	310919	300480	0	0.00	0	0	0	0	0	0	0	0	0.000	300480.
13	0	-13073	310518	297445	0	0.00	0	0	0	0	0	0	0	0	0.000	297446.
14	0	-6162	302715	296553	0	0.00	0	0	0	0	0	0	0	0	0.000	296553.
15	0	-9903	313905	333103	0	0.00	0	0	29101	0	0	0	0	0	0.000	333103.
16	0	-18605	324103	305498	0	0.00	0	0	0	0	0	0	0	0	0.000	305499.
17	0	-16096	296582	280486	0	0.00	0	0	0	0	0	0	0	0	0.000	280487.
18	0	-33923	332043	298120	0	0.00	0	0	0	0	0	0	0	0	0.000	298120.
19	0	-34257	313910	279653	0	0.00	0	0	0	0	0	0	0	0	0.000	279654.
20	0	23827	537742	263944	0	0.00	0	0	0	0	0	297625	0	0	0.000	263944.
21	0	145350	237000	319379	0	0.00	0	0	0	0	0	62971	0	0	0.000	319379.
22	0	18287	397027	266443	0	0.00	0	0	0	0	0	148871	0	0	0.000	266444.
23	0	112164	214656	230006	0	0.00	0	0	0	0	0	96814	0	0	0.000	230007.
24	0	22391	243336	265727	0	0.00	0	0	0	0	0	0	0	0	0.000	265728.
25	0	-37632	313993	276361	0	0.00	0	0	0	0	0	0	0	0	0.000	276361.
26	0	-9967	312787	302820	0	0.00	0	0	0	0	0	0	0	0	0.000	302821.
27	0	10355	321940	332295	0	0.00	0	0	0	0	0	0	0	0	0.000	332296.
28	0	-17514	341488	323974	0	0.00	0	0	13875	0	0	0	0	0	0.000	337850.
29	0	-22596	367691	345105	0	0.00	0	0	18470	0	0	0	0	0	0.000	363576.
30	0	-6618	393248	386630	0	0.00	0	0	25717	0	0	0	0	0	0.000	412348.
31	0	-4333	420297	415964	0	0.00	0	0	32009	0	0	0	0	0	0.000	447973.
32	0	777	366163	366940	0	0.00	0	0	50566	0	0	0	0	0	0.000	417507.
33	0	-22463	376228	353765	0	0.00	0	0	66875	0	0	0	0	0	0.000	420641.
34	0	-23359	353299	329940	0	0.00	0	0	83937	0	0	0	0	0	0.000	413877.
35	0	7003	229969	236972	0	0.00	0	0	92212	0	0	0	0	0	0.000	319185.
36	0	-9768	315446	305678	0	0.00	0	0	121026	0	0	0	0	0	0.000	426704.

YEAR TOTALS -129369.12368248.11661699. 0. 0. 523788. 0. 0. 606281. 12156406.

DEMAND NODE 4 NODE.4

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	0	0	33796	0.0
2	0	0	30970	0.0
3	0	0	35480	0.0
4	0	0	31890	0.0
5	0	0	31904	0.0
6	0	0	32118	0.0
7	0	0	41227	0.0
8	0	0	39660	0.0
9	0	0	58134	0.0
10	0	0	71955	0.0
11	0	0	89753	0.0
12	0	0	113378	0.0
13	0	0	129050	0.0
14	0	0	126392	0.0
15	0	0	144977	0.0
16	0	0	197860	0.0
17	0	0	248070	0.0
18	0	0	351079	0.0
19	0	0	384249	0.0
20	0	0	512889	0.0
21	0	0	449211	0.0
22	0	0	573441	0.0
23	0	0	311213	0.0
24	0	0	276450	0.0
25	0	0	193309	0.0
26	0	0	161512	0.0
27	0	0	103879	0.0
28	0	0	86288	0.0
29	0	0	62997	0.0
30	0	0	56896	0.0
31	0	0	45112	0.0
32	0	0	41435	0.0
33	0	0	38267	0.0
34	0	0	35835	0.0
35	0	0	34147	0.0
36	0	0	36718	0.0
YEAR TOTALS	0.	0.	5211541.	0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 1 CALENDAR YEAR 1964

DEMAND NODE 5 NODE.5

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	247937	0	0	247937.5
2	247937	0	0	247937.5
3	247937	0	0	247937.5
4	247937	0	0	247937.5
5	247937	0	0	247937.5
6	198350	0	0	198350.0
7	247937	0	0	247937.5
8	247937	0	0	247937.5
9	272731	0	0	272731.3
10	247937	0	0	247937.5
11	247937	0	0	247937.5
12	247937	0	0	247937.5
13	247937	0	0	247937.5

14	247937	0	0	247937.5
15	272731	0	0	272731.3
16	247937	0	0	247937.5
17	247937	0	0	247937.5
18	247937	0	0	247937.5
19	247937	0	0	247937.5
20	247937	0	0	247937.5
21	272731	0	0	272731.3
22	247937	0	0	247937.5
23	247937	0	0	247937.5
24	272731	0	0	272731.3
25	247937	0	0	247937.5
26	247937	0	0	247937.5
27	247937	0	0	247937.5
28	247937	0	0	247937.5
29	247937	0	0	247937.5
30	272731	0	0	272731.3
31	247937	0	0	247937.5
32	247937	0	0	247937.5
33	247937	0	0	247937.5
34	247937	0	0	247937.5
35	247937	0	0	247937.5
36	272731	0	0	272731.3
YEAR TOTALS	9024909.	0.	0.	9024926.

DEMAND NODE 6 NODE.6

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	129899	0	183918	129899.4
2	200928	0	86696	200928.5
3	201013	0	72030	201013.8
4	142772	0	37851	142772.3
5	148069	405	44515	148474.9
6	81314	1417	19394	82731.8
7	148717	3740	48754	152457.8
8	120761	3465	82793	124226.6
9	136025	2919	39773	138944.2
10	202006	5349	65719	207355.1
11	189021	19603	57590	208624.5
12	141758	31897	101916	173655.4
13	144801	51496	30107	196297.1
14	163745	51385	34996	215130.4
15	195819	40820	36181	236639.5
16	227785	0	69882	227785.1
17,	218561	0	45209	218561.9
18	203636	0	61024	203636.0
19	209586	0	70878	209586.5
20	184832	0	282142	184832.5
21	130157	0	63372	130157.3
22	98113	0	235951	98113.8
23	96398	0	147943	96398.1
24	170085	0	91322	170085.1
25	211044	0	80930	211044.4
26	239210	0	64235	239210.1
27	249345	0	19868	249345.8
28	218760	0	43039	218760.2
29	203040	0	47685	203041.0
30	197576	0	36062	197576.4
31	205024	0	22189	205024.5
32	209348	0	26509	209348.5
33	187797	0	40776	187797.8
34	171344	0	94658	171344.6
35	190713	0	90207	190713.5
36	124097	0	128733	124097.7
YEAR TOTALS	6293099.	212496.	2704347.	6505612.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 1 CALENDAR YEAR 1964

DEMAND NODE 7 NODE.7

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	0	0	70233	0.0
2	0	0	15312	0.0
3	0	0	18553	0.0
4	0	0	33493	0.0
5	0	0	40048	0.0
6	0	0	-1263	0.0
7	0	0	11484	0.0
8	0	0	5014	0.0
9	0	0	3540	0.0
10	0	0	28215	0.0
11	0	0	33554	0.0
12	0	0	36109	0.0
13	0	0	25055	0.0
14	0	0	-1410	0.0
15	0	0	-7803	0.0
16	0	0	23280	0.0
17	0	0	50057	0.0
18	0	0	106387	0.0
19	0	0	113805	0.0
20	0	0	440432	0.0
21	0	0	237000	0.0
22	0	0	259189	0.0
23	0	0	163111	0.0
24	0	0	62285	0.0
25	0	0	31079	0.0
26	0	0	28588	0.0
27	0	0	4250	0.0
28	0	0	11716	0.0
29	0	0	-4066	0.0
30	0	0	-5194	0.0
31	0	0	813	0.0
32	0	0	15990	0.0
33	0	0	17349	0.0
34	0	0	58663	0.0
35	0	0	26436	0.0
36	0	0	46848	0.0
YEAR TOTALS	0.	0.	1998152.	0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 1 CALENDAR YEAR 1964

LINK NO / PERIOD	1	2	3	4	5	6	7
1	17038	124999	0	27234	164179	199588	0
2	15613	182590	57591	0	208420	216140	0
3	17887	190027	65027	0	239128	248482	0
4	16077	177896	52896	0	204502	221388	0
5	16084	177207	52207	0	191669	211859	0
6	16192	131217	31217	0	151185	150548	0
7	20784	175397	50397	0	155731	161521	0
8	19994	144141	19141	0	158995	161523	0
9	29308	186026	48526	0	165647	167432	0
10	36276	193710	68710	0	142213	156438	0
11	45249	191261	66262	0	138689	155605	0

12	57160	145086	20086	0	138548	156752	0
13	65061	182823	57824	0	143918	156550	0
14	63721	189909	64910	0	153327	152616	0
15	73091	254244	116744	36261	125930	121996	0
16	74999	305357	180357	100749	50913	62649	24753
17	74999	252325	127325	39928	84359	109596	50067
18	74999	196898	71899	0	113766	167402	102000
19	74999	194930	69930	0	100884	158260	118722
20	74999	124999	0	49059	0	222047	183578
21	74999	171170	33670	0	0	119485	151474
22	74999	124999	0	69492	0	130672	214105
23	74999	124999	0	25986	0	82233	81901
24	74999	177208	39709	0	91278	122680	64375
25	74999	190597	65598	0	142633	158302	22458
26	74999	213215	88215	0	143281	157694	6428
27	52371	240692	115692	0	160166	162309	0
28	43502	213591	88591	0	166257	172164	0
29	31760	203323	78323	0	187424	185374	0
30	28684	218928	81428	0	200878	198259	0
31	22743	217177	92177	0	211486	211896	0
32	20889	217179	92179	0	176542	184604	0
33	19292	199121	74122	0	180932	189678	0
34	18066	163661	38661	0	148543	178118	0
35	17215	175670	50671	0	102613	115941	0
36	18511	137499	0	2337	133078	156697	0

POWER GENERATION IN THE SYSTEM
****

RESERVOIR NO = 1

PERIOD	R.LEVEL	TW.LEVEL	DISCHARGE	NET HEAD	POWE IN M.W
1	1591.60	1167.78	12499.97	419.82	395.52
2	1583.81	1169.74	18259.09	410.07	568.45
3	1573.13	1169.41	17275.25	399.72	526.92
4	1561.67	1169.58	17789.66	388.09	528.84
5	1549.97	1169.56	17720.75	376.41	513.47
6	1539.98	1169.10	16402.19	366.68	460.77
7	1530.75	1169.50	17539.70	357.25	484.61
8	1518.82	1168.47	14414.17	346.36	381.84
9	1505.26	1169.28	16911.47	331.98	431.62
10	1487.52	1170.12	19371.01	313.39	469.98
11	1471.90	1170.04	19126.19	297.86	442.66
12	1463.39	1168.50	14508.65	290.88	323.26
13	1462.49	1169.75	18282.38	288.73	405.63
14	1462.95	1170.00	18990.97	288.95	426.81
15	1462.11	1171.37	23113.14	286.74	508.37
16	1462.51	1172.00	30535.77	286.51	647.83
17	1473.29	1172.00	25232.52	297.29	572.43
18	1508.74	1170.23	19689.89	334.51	509.46
19	1536.67	1170.16	19493.07	362.51	547.39
20	1571.55	1167.78	12499.97	399.77	380.11
21	1604.87	1168.83	15560.92	432.04	503.61
22	1631.91	1167.78	12499.97	460.13	423.03
23	1652.03	1167.78	12499.97	480.25	435.14
24	1662.81	1169.00	16109.91	489.81	572.80
25	1668.88	1170.02	19059.79	494.86	683.56
26	1670.70	1170.77	21321.50	495.93	770.73
27	1668.61	1171.76	24069.27	492.85	864.08
28	1664.53	1170.79	21359.11	489.74	762.18
29	1659.80	1170.44	20332.34	485.35	720.56
30	1653.44	1170.30	19902.61	479.14	698.20

31	1646.12	1170.91	21717.77	471.22	742.51
32	1638.15	1170.91	21717.97	463.24	726.05
33	1630.11	1170.30	19912.17	455.80	669.05
34	1623.26	1169.09	16366.17	450.17	548.33
35	1616.37	1169.51	17567.08	442.86	584.72
36	1610.24	1167.78	12499.99	438.46	409.79

RESERVOIR NO = 2

PERIOD	R.LEVEL	TW.LEVEL	DISCHARGE	NFT HFAD	POWE IN M.W
1	1374.80	1090.55	16417.95	280.25	360.00
2	1372.20	1092.32	20842.10	275.87	360.00
3	1368.38	1092.68	21738.98	271.69	360.00
4	1364.15	1092.17	20450.26	267.97	360.00
5	1342.65	1091.65	19166.93	247.00	360.00
6	1335.94	1091.54	18898.16	240.40	360.00
7	1330.24	1090.20	15573.18	236.04	345.14
8	1323.89	1090.33	15899.52	229.56	352.39
9	1316.69	1089.98	15053.87	222.70	333.71
10	1309.56	1089.63	14221.33	215.93	315.10
11	1302.48	1089.49	13868.92	208.99	301.42
12	1294.63	1089.48	13854.80	201.14	293.48
13	1286.49	1089.70	14391.88	192.79	293.80
14	1276.85	1090.10	15332.74	182.75	295.59
15	1265.66	1088.52	11448.22	173.14	207.14
16	1259.96	1085.95	5091.30	170.00	87.43
17	1259.96	1087.31	8435.95	168.65	146.75
18	1263.52	1088.49	11376.66	171.03	202.97
19	1269.65	1087.96	10099.48	177.69	187.56
20	1291.08	0.00	0.00	0.00	0.00
21	1319.07	0.00	0.00	0.00	0.00
22	1340.45	0.00	0.00	0.00	0.00
23	1367.92	0.00	0.00	0.00	0.00
24	1370.74	1087.25	8298.05	279.49	183.48
25	1370.56	1089.65	14263.37	276.91	316.03
26	1369.16	1089.68	14328.16	275.48	317.47
27	1366.99	1090.38	16016.64	272.61	354.99
28	1364.15	1090.63	16625.76	269.52	360.00
29	1343.60	1091.48	18742.47	248.12	360.00
30	1336.14	1091.28	18261.66	240.86	360.00
31	1327.73	1092.44	21149.68	231.29	360.00
32	1318.83	1091.02	17654.30	223.81	360.00
33	1310.17	1091.21	18093.22	214.97	360.00
34	1301.71	1089.90	14854.35	207.81	321.62
35	1294.89	1088.03	10261.31	202.87	218.68
36	1288.67	1088.79	12098.08	195.88	251.36

SYSTEM TOTAL POWER GENERATED IN M.W

755.52	928.45	886.92	888.84	873.47	820.77
829.75	734.23	765.33	785.08	744.07	616.74
699.42	722.40	715.51	735.26	719.19	712.44
734.95	380.11	503.61	423.03	435.14	756.28
999.59	1088.20	1219.08	1122.18	1080.56	1058.20
1102.51	1086.05	1029.05	869.95	803.40	661.15

SYSTFM OFERATION STUDY BY N . I . H .

SIMULATION YEAR 2 CALENDAR YEAR 1965

RESFRVOIR NO 1 RFSV.1 MAX. CAPACITY 7424550 MIN. OFERATING POOL 1619560

PERID	INITIAL SRORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
1	4496980	81125	0	0	28311	0.06	1642	439312	0	0	0	0	4137151	4136735	1.000	0.
2	4137151	70374	28429	0	26790	0.06	1554	367437	0	0	0	0	3866963	4136992	1.000	0.
3	3866963	104881	33546	0	25624	0.06	1486	347294	0	0	0	0	3656610	4143628	1.000	0.
4	3656610	87214	0	0	24392	0.08	1951	375472	0	0	0	0	3366401	3365675	1.000	0.
5	3366401	71584	32095	0	23103	0.08	1848	322885	0	0	0	0	3145347	3376583	1.000	0.
6	3145347	70334	28810	0	22213	0.08	1777	221731	0	0	0	0	3020983	3358817	1.000	0.
7	3020983	81502	0	0	20737	0.14	2802	498718	0	0	0	0	2600965	2599469	1.000	0.
8	2600965	75868	47528	0	18935	0.14	2556	332031	0	0	0	0	2389774	2612723	0.997	0.
9	2389774	133027	86347	0	17829	0.14	2407	312136	0	0	0	0	2294605	2615599	1.000	0.
10	2294605	103856	88680	0	16605	0.19	3138	397772	0	0	0	0	2086231	2668398	1.000	0.
11	2086231	147830	99887	0	15391	0.19	2909	457449	0	0	0	0	1873590	2328504	0.996	0.
12	1873590	173258	148762	0	14952	0.19	2826	334548	0	0	0	0	1858236	2328513	0.906	0.
13	1858236	312321	83102	0	15201	0.22	3299	247937	0	0	0	0	2002423	1999567	0.846	0.
14	2002423	316209	148762	0	15569	0.22	3379	414989	0	0	0	0	2049026	2304527	1.000	0.
15	2049026	454610	148762	0	15839	0.22	3437	514907	0	0	0	0	2134054	2306212	1.000	0.
16	2134054	312678	148762	0	15698	0.15	2308	611489	0	0	0	0	1981697	2548671	1.000	0.
17	1981697	288123	148762	0	14797	0.15	2175	646607	0	0	0	0	1769800	2545770	1.000	0.
18	1769800	645946	148762	0	15097	0.15	2219	428523	0	0	0	0	2133766	2544196	1.000	0.
19	2133766	648168	148762	0	17568	0.12	2091	415096	0	0	0	0	2513509	4450539	1.000	0.
20	2513509	888290	148762	0	20889	0.12	2486	382668	0	0	0	0	[illegible]5407	4439592	1.000	0.
21	3165407	1228948	148762	0	25357	0.12	3018	272731	0	0	0	0	4267369	4450061	1.000	0.
22	4267368	1066482	148762	0	30460	0.10	3168	257329	0	0	0	0	5242115	7195430	1.000	0.
23	5242115	914195	148762	0	34507	0.10	3589	309616	0	0	0	0	5991867	7209263	1.000	0.
24	5991867	653115	148762	0	36932	0.10	3841	421591	0	0	0	0	6368312	7217455	1.000	0.
25	6368312	370537	148762	0	37829	0.10	3972	447315	0	0	0	0	6436324	7335609	1.000	0.
26	6436324	260770	122552	0	37760	0.10	3965	482550	0	0	0	0	6333131	7360025	1.000	0.
27	6333131	222310	109622	0	37262	0.10	3912	478963	0	0	0	0	6182188	7338795	1.000	0.
28	6182188	188373	72096	0	36559	0.11	3912	450366	0	0	0	0	5988379	6710306	0.997	0.
29	5988379	150150	46308	0	35464	0.11	3816	427173	0	0	0	0	5753843	6676885	0.998	0.
30	5753843	146620	54792	0	34604	0.11	3703	469796	0	0	0	0	5481766	6677047	1.000	0.
31	5481766	144418	60419	0	33587	0.07	2217	382218	0	0	0	0	5302168	5842349	1.000	0.
32	5302168	116272	45001	0	32615	0.07	2153	370499	0	0	0	0	5090789	5927912	1.000	0.
33	5090789	114725	39271	0	31644	0.07	2089	329679	0	0	0	0	4913017	5835135	1.000	0.
34	4913017	105323	36819	0	30799	0.05	1663	304038	0	0	0	0	4749459	5251348	1.000	0.
35	4749458	95327	33608	0	27805	0.05	1609	372449	0	0	0	0	4504335	5271098	1.000	0.
36	4504335	90677	33727	0	28658	0.05	1548	353168	0	0	0	0	4274023	5278166	1.000	0.
YEAR TOTALS		10955440.	3116545.	0.			96465.	14198477.		0.	0.		0.	0.		0.

RESERVOIR NO 2 RESV.2 MAX. CAPACITY 6975000 MIN. OPERATING POOL 1044000

PERID	INITIAL SRORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
1	1626923	42985	0	0	27125	0.06	1573	53474	0	3067[illegible]	0	0	1645437	3199956	0.675	0.
2	1645437	33971	0	0	25955	0.06	1505	227489	0	0	0	0	1450414	3212643	0.707	0.
3	1450414	62275	0	0	23441	0.06	1360	242495	0	0	0	0	1268834	3207767	0.659	0.
4	1268834	98825	0	0	22175	0.08	1774	137245	0	33136	0	0	1261776	2856313	0.592	0.
5	1261776	60256	0	0	21390	0.08	1711	168189	0	0	0	0	1152132	2950444	0.600	0.
6	1152132	40467	0	0	20061	0.08	1605	125478	0	0	0	0	1065516	2844392	0.567	0.
7	1065516	64158	0	0	19936	0.14	2691	39184	0	44793	0	0	1132592	1930705	0.528	0.
8	1132592	63158	0	0	19826	0.14	2677	143377	0	0	0	0	1049696	1984937	0.609	0.
9	1049696	153169	0	0	19605	0.14	2647	100409	0	0	0	0	1099809	1981769	0.618	0.
10	1099809	103485	0	0	19572	0.19	3699	155600	0	0	0	0	1043995	1948015	0.778	0.
11	1043995	93282	0	0	19181	0.19	3625	136037	0	46389	0	0	1043995	1600497	0.706	0.
12	1043995	66336	0	0	19181	0.19	3625	69354	0	6643	0	0	1043995	[illegible]	0.711	0.
13	1043995	77102	0	0	20017	0.22	4344	60766	0	109345	0	0	1165332	1549877	0.700	0.
14	1165332	57313	0	0	20018	0.22	4344	[illegible]	0	16721	0	0	1043993	1921735	1.000	0.
15	1043993	73234	0	0	19185	0.22	4163	148644	0	79574	0	0	1043994	1926560	0.746	0.
16	1043994	71548	0	0	19176	0.15	2819	95493	0	25757	0	0	1043997	1044000	1.000	0.
17	1043997	28990	0	0	19176	0.15	2819	37072	0	10901	0	0	1043977	1044000	1.000	0.
18	1043997	121146	0	0	19508	0.15	2968	219687	0	[illegible]	0	0	1091489	1044000	1.000	0.
19	1091489	347731	0	0	21844	0.12	2597	176871	0	129657	0	0	1389417	2615040	1.000	0.
20	1389417	627482	0	0	29004	0.12	3451	0	0	233339	0	0	2246787	2615685	1.000	0.

21	2246787	895861	0	0	39673	0.12	4721	107519	0	514355	0	0	3544763	2614523	1.000	0.
22	3544763	406599	0	0	48225	0.10	5015	0	0	435329	0	0	4381676	5149732	1.000	0.
23	4381676	494444	0	0	53493	0.10	5563	46418	0	325203	0	0	5149342	5150641	1.000	0.
24	5149342	352346	0	0	56540	0.10	5880	172751	0	144095	0	0	5467152	5141227	1.000	0.
25	5467152	120578	0	0	56895	0.10	5974	326561	0	32406	0	0	5287601	5629103	1.000	0.
26	5287601	92272	0	0	55844	0.10	5864	316393	0	0	0	0	5057616	5667428	1.00	0.
27	5057616	97631	0	0	54553	0.10	5728	364621	0	0	0	0	4784898	5627293	1.000	0.
28	4784898	72937	0	0	53114	0.11	5683	309534	0	0	0	0	4542618	4725795	1.000	0.
29	4542618	56390	0	0	51264	0.11	5485	373830	0	0	0	0	4219693	4720119	1.000	0.
30	4219693	46013	0	0	48831	0.11	5225	425861	0	0	0	0	3834620	4701299	1.000	0.
31	3834620	77174	0	0	45996	0.07	3036	448899	0	0	0	0	3459859	3902002	1.000	0.
32	3459859	46513	0	0	42988	0.07	2837	421298	0	0	0	0	3082237	3914500	1.000	0.
33	3082237	47715	0	0	39979	0.07	2639	404728	0	0	0	0	2722585	3890667	0.978	0.
34	2722585	40800	0	0	37067	0.05	2002	363922	0	0	0	0	2397461	3336290	0.933	0.
35	2397461	33366	0	0	34425	0.05	1859	277661	0	0	0	0	2151307	3336168	0.868	0.
36	2151307	29082	0	0	31518	0.05	1702	337932	0	0	0	0	1840755	3340398	0.823	0.

YEAR TOTALS 5196534. 0. 0. 125112. 7225811. 0.2368221. 0. 0. 0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 2 CALENDAR YEAR 1965

RESERVOIR NO 3 RESV.3 MAX. CAPACITY 0 MIN. OPERATING POOL 0

PERID	INITIAL SRORAGE	UREG INFLOWS	UPSTRM SPILLS	DEMAND	SURFACE AREA	EVAP RATE	EVAP LOSS	DOWNSTRM SPILLS	SHORTAGE	DIVERTED INTO	DIVERTED OUT	SYSTEM LOSS	END PER CONTENT	OPERTG RULE	RF	ACT DEMD
1	0	34019	240574	274593	0	0.00	0	0	132460	0	0	0	0	0	0.000	407054.
2	0	42891	259453	302344	0	0.00	0	0	125338	0	0	0	0	0	0.000	427682.
3	0	20822	289275	310097	0	0.00	0	0	160571	0	0	0	0	0	0.000	470669.
4	0	1432	247259	248691	0	0.00	0	0	171255	0	0	0	0	0	0.000	419947.
5	0	33515	205956	239471	0	0.00	0	0	159609	0	0	0	0	0	0.000	399080.
6	0	14947	150981	165928	0	0.00	0	0	126963	0	0	0	0	0	0.000	292892.
7	0	1015	157278	158293	0	0.00	0	0	141770	0	0	0	0	0	0.000	300064.
8	0	3911	179091	183002	0	0.00	0	0	117537	0	0	0	0	0	0.000	300540.
9	0	22419	181913	204332	0	0.00	0	0	126196	0	0	0	0	0	0.000	330528.
10	0	-47526	280959	233433	0	0.00	0	0	66630	0	0	0	0	0	0.000	300064.
11	0	-13118	224896	211778	0	0.00	0	0	88127	0	0	0	0	0	0.000	299905.
12	0	-86157	299734	213577	0	0.00	0	0	86903	0	0	0	0	0	0.000	300480.
13	0	-9850	218028	208178	0	0.00	0	0	89267	0	0	0	0	0	0.000	297446.
14	0	65774	230779	296553	0	0.00	0	0	0	0	0	0	0	0	0.000	296553.
15	0	62861	185735	248596	0	0.00	0	0	84507	0	0	0	0	0	0.000	333103.
16	0	9233	296265	305498	0	0.00	0	0	0	0	0	0	0	0	0.000	305499.
17	0	40187	240299	280486	0	0.00	0	0	0	0	0	0	0	0	0.000	280487.
18	0	24474	273646	298120	0	0.00	0	0	0	0	0	0	0	0	0.000	298120.
19	0	20035	259618	279653	0	0.00	0	0	0	0	0	0	0	0	0.000	279654.
20	0	274419	99627	263944	0	0.00	0	0	0	0	0	110102	0	0	0.000	263944.
21	0	22756	296623	319379	0	0.00	0	0	0	0	0	0	0	0	0.000	319379.
22	0	72397	195777	266443	0	0.00	0	0	0	0	0	1731	0	0	0.000	266444.
23	0	19418	210588	230006	0	0.00	0	0	0	0	0	0	0	0	0.000	230007.
24	0	-7775	273502	265727	0	0.00	0	0	0	0	0	0	0	0	0.000	265728.
25	0	-42034	318395	276361	0	0.00	0	0	0	0	0	0	0	0	0.000	276361.
26	0	-718	303538	302820	0	0.00	0	0	0	0	0	0	0	0	0.000	302821.
27	0	-29135	361430	332295	0	0.00	0	0	0	0	0	0	0	0	0.000	332296.
28	0	9800	328049	337849	0	0.00	0	0	0	0	0	0	0	0	0.000	337850.
29	0	1576	361999	363575	0	0.00	0	0	0	0	0	0	0	0	0.000	363576.
30	0	-628	412975	412347	0	0.00	0	0	0	0	0	0	0	0	0.000	412348.
31	0	-11359	459332	447973	0	0.00	0	0	0	0	0	0	0	0	0.000	447973.
32	0	-7007	424513	417506	0	0.00	0	0	0	0	0	0	0	0	0.000	417507.
33	0	-9199	420631	411432	0	0.00	0	0	9208	0	0	0	0	0	0.000	420641.
34	0	-31053	417218	386165	0	0.00	0	0	27712	0	0	0	0	0	0.000	413877.
35	0	8326	268656	276982	0	0.00	0	0	42202	0	0	0	0	0	0.000	319185.
36	0	39303	311943	351246	0	0.00	0	0	75458	0	0	0	0	0	0.000	426704.

YEAR TOTALS 549971. 9886535.10324673. 0. 0. 1831713. 0. 0. 111833. 12156406.

DEMAND NODE 4 NODE.4

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	0	0	30676	0.0
2	0	0	28429	0.0
3	0	0	33546	0.0
4	0	0	33136	0.0
5	0	0	32095	0.0
6	0	0	28810	0.0
7	0	0	44793	0.0
8	0	0	47528	0.0
9	0	0	86347	0.0
10	0	0	88680	0.0
11	0	0	146267	0.0
12	0	0	155405	0.0
13	0	0	192447	0.0
14	0	0	165483	0.0
15	0	0	228336	0.0
16	0	0	175519	0.0
17	0	0	159663	0.0
18	0	0	297663	0.0
19	0	0	278429	0.0
20	0	0	382101	0.0
21	0	0	663117	0.0
22	0	0	584091	0.0
23	0	0	473965	0.0
24	0	0	292857	0.0
25	0	0	181168	0.0
26	0	0	122552	0.0
27	0	0	109622	0.0
28	0	0	72096	0.0
29	0	0	46308	0.0
30	0	0	54792	0.0
31	0	0	60419	0.0
32	0	0	45001	0.0
33	0	0	39271	0.0
34	0	0	36819	0.0
35	0	0	33608	0.0
36	0	0	33727	0.0
YEAR TOTALS	0.	0.	5484766.	0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 2 CALENDAR YEAR 1965

DEMAND NODE 5 NODE.5

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	247937	0	0	247937.5
2	247937	0	0	247937.5
3	247937	0	0	247937.5
4	247937	0	0	247937.5
5	247937	0	0	247937.5
6	198350	0	0	198350.0
7	247937	0	0	247937.5
8	247937	0	0	247937.5
9	272731	0	0	272731.3
10	247937	0	0	247937.5
11	247937	0	0	247937.5
12	247937	0	0	247937.5
13	247937	0	0	247937.5
14	247937	0	0	247937.5

15	272731	0	0	272731.3
16	247937	0	0	247937.5
17	247937	0	0	247937.5
18	247937	0	0	247937.5
19	247937	0	0	247937.5
20	247937	0	0	247937.5
21	272731	0	0	272731.3
22	247937	0	0	247937.5
23	247937	0	0	247937.5
24	272731	0	0	272731.3
25	247937	0	0	247937.5
26	247937	0	0	247937.5
27	247937	0	0	247937.5
28	247937	0	0	247937.5
29	247937	0	0	247937.5
30	272731	0	0	272731.3
31	247937	0	0	247937.5
32	247937	0	0	247937.5
33	247937	0	0	247937.5
34	247937	0	0	247937.5
35	247937	0	0	247937.5
36	272731	0	0	272731.3
YEAR TOTALS	9024909.	0.	0.	9024926.

DEMAND NODE 6 NODE.6

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	129899	0	78889	129899.4
2	200928	0	81428	200928.5
3	201013	0	101656	201013.8
4	142772	0	68357	142772.3
5	148474	0	73526	148474.9
6	82731	0	59350	82731.8
7	152457	0	17101	152457.8
8	123865	361	39771	124226.6
9	138944	0	99539	138944.2
10	207355	0	120362	207355.1
11	207737	887	55807	208624.5
12	157265	16390	233574	173655.4
13	165972	30325	268450	196297.1
14	215130	0	56922	215130.4
15	236639	0	6868	236639.5
16	227785	0	35935	227785.1
17	218561	0	24129	218561.9
18	203636	0	23050	203636.0
19	209586	0	42427	209586.5
20	184832	0	50101	184832.5
21	130157	0	162287	130157.3
22	98113	0	88721	98113.8
23	96398	0	34719	96398.1
24	170085	0	21225	170085.1
25	211044	0	11666	211044.4
26	239210	0	4597	239210.1
27	249345	0	18319	249345.8
28	218174	586	15745	218760.2
29	202543	497	23302	203041.0
30	197576	0	521	197576.4
31	205024	0	70743	205024.5
32	209348	0	86786	209348.5
33	187797	0	106055	187797.8
34	171344	0	115243	171344.6
35	190713	0	66201	190713.5
36	124097	0	43660	124097.7
YEAR TOTALS	6456549.	49046.	2407032.	6505612.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 2 CALENDAR YEAR 1965

DEMAND NODE 7 NODE.7

MONTH	DEMAND	SHORTAGE,	UREG.FLOW	ACT.DEMD
1	0	0	46735	0.0
2	0	0	31964	0.0
3	0	0	46780	0.0
4	0	0	56894	0.0
5	0	0	37767	0.0
6	0	0	25503	0.0
7	0	0	2669	0.0
8	0	0	35714	0.0
9	0	0	81504	0.0
10	0	0	62517	0.0
11	0	0	31277	0.0
12	0	0	67460	0.0
13	0	0	54784	0.0
14	0	0	30906	0.0
15	0	0	24686	0.0
16	0	0	29080	0.0
17	0	0	-1011	0.0
18	0	0	53959	0.0
19	0	0	82747	0.0
20	0	0	99627	0.0
21	0	0	[illegible]974	0.0
22	0	0	[illegible]5777	0.0
23	0	0	[illegible]70	0.0
24	0	0	100751	0.0
25	0	0	-[illegible]166	0.0
26	0	0	-1[illegible]855	0.0
27	0	0	-3191	0.0
28	0	0	[illegible]8515	0.0
29	0	0	-11831	0.0
30	0	0	[illegible]2886	0.0
31	0	0	10433	0.0
32	0	0	3215	0.0
33	0	0	15903	0.0
34	0	0	53296	0.0
35	0	0	-9005	0.0
36	0	0	-25989	0.0
YEAR TOTALS	0.	0.	1536673.	0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION YEAR 2 CALENDAR YEAR 1965

LINK NO	1	2	3	4	5	6	7
PERIOD							
1	0	221483	96483	70766	26959	50521	15465
2	14332	185246	60247	0	114690	130805	0
3	16912	175091	50091	0	122256	145840	0
4	0	189297	64297	26780	69193	97876	16705
5	16180	162785	37785	0	84794	103834	0
6	14524	111787	11787	0	63260	76118	0
7	0	251433	126433	58192	19754	21100	22582
8	23961	167396	42396	0	72284	90290	0
9	43532	157366	19856	0	50622	91713	0
10	44708	200540	75540	31682	79447	109965	0
11	50358	230627	105627	29030	68584	84352	23382
12	74999	168665	43665	82137	34965	68976	3349

13	41896	124999	0	51665	30635	58255	55127
14	74999	209220	84220	4458	96309	111890	8430
15	74999	259595	122095	6254	74940	87385	40117
16	74999	308287	183288	86565	48138	62799	13489
17	74999	325992	200993	102968	18690	18180	5495
18	74999	216043	91044	0	110757	137961	75069
19	74999	209274	84274	0	89171	130888	65372
20	74999	192925	67925	0	0	50227	117640
21	74999	137499	0	16198	54206	133346	259316
22	74999	129734	4735	0	0	98702	219475
23	74999	156095	31096	0	23402	106169	163954
24	74999	212549	75049	0	87094	137888	72646
25	74999	225518	100518	0	164638	160521	16337
26	61785	243282	118282	0	159512	153031	0
27	55266	241473	116473	0	183827	182218	0
28	36347	227056	102056	0	156054	165388	0
29	23346	215365	90366	0	188469	182505	0
30	27623	236846	99347	0	214701	208205	0
31	30460	192698	67699	0	226316	231576	0
32	22687	186790	61790	0	212401	214022	0
33	19798	166210	41210	0	204047	212065	0
34	18562	153283	28283	0	183474	210344	0
35	16943	187773	62773	0	139985	135445	0
36	17003	178052	40553	0	170371	157268	0

POWER GENERATION IN THE SYSTEM
****

RESERVOIR NO = 1

PERIOD	R.LEVEL	TW.LEVEL	DISCHARGE	NET HEAD	POWE IN M.W
1	1601.73	1171.05	22148.32	426.68	700.67
2	1590.59	1169.84	18524.68	416.75	585.22
3	1581.17	1168.94	15917.41	408.23	494.30
4	1571.15	1169.98	18929.77	397.18	575.18
5	1559.76	1169.06	16278.55	386.70	481.46
6	1551.89	1168.30	13973.47	379.58	405.98
7	1539.08	1172.00	25143.33	363.08	711.68
8	1524.20	1169.22	16739.65	350.98	450.31
9	1515.18	1168.43	14306.02	342.75	374.36
10	1505.18	1170.35	20054.04	330.83	511.97
11	1489.28	1171.35	23062.72	313.92	547.66
12	1481.15	1169.26	16866.55	307.88	400.39
13	1485.76	1167.78	12499.97	313.98	302.76
14	1492.57	1170.64	20922.06	317.93	509.95
15	1497.57	1171.55	23599.56	322.03	575.12
16	1494.96	1172.00	30828.79	318.96	739.72
17	1479.11	1172.00	32599.29	303.11	730.69
18	1483.83	1170.87	21604.38	308.97	511.87
19	1513.04	1170.64	20927.45	338.40	543.97
20	1540.17	1170.10	19292.56	366.07	547.03
21	1579.00	1167.78	12499.99	407.22	385.87
22	1617.34	1167.94	12973.48	445.40	428.66
23	1643.32	1168.85	15609.58	470.48	536.49
24	1659.23	1170.11	19322.64	485.12	684.13
25	1665.03	1171.18	22551.80	489.84	807.66
26	1664.58	1171.88	24328.21	488.70	867.26
27	1661.37	1171.79	24147.37	485.57	859.15
28	1656.78	1171.24	22705.62	481.55	802.89
29	1650.91	1170.85	21536.58	476.07	744.34
30	1643.96	1170.84	21531.54	469.12	728.46
31	1637.39	1170.09	19269.88	463.30	659.23

32	1631.26	1169.89	18679.05	457.37	634.01
33	1625.14	1169.18	16621.07	451.96	559.19
34	1619.78	1168.76	15328.36	447.02	507.46
35	1612.63	1169.92	18777.36	438.70	619.30
36	1604.27	1169.03	16186.63	431.24	525.08

RESERVOIR NO = 2

PERIOD	R.LEVEL	TW.LEVEL	DISCHARGE	NET HEAD	POWE IN M.W
1	1285.48	1085.33	2695.94	196.15	56.06
2	1282.32	1088.53	11469.07	189.79	230.07
3	1274.62	1088.38	11114.19	182.24	212.97
4	1270.42	1086.67	6919.33	179.75	129.45
5	1267.82	1087.32	8479.40	176.50	155.85
6	1263.42	1087.09	7907.61	172.33	140.92
7	1262.98	1085.24	1975.50	173.74	1.00
8	1262.55	1086.80	7228.48	171.74	127.87
9	1261.67	1085.75	4602.01	171.91	79.84
10	1261.53	1087.06	7844.72	170.47	137.91
11	1259.98	1086.65	6858.43	169.33	118.92
12	1259.98	1085.44	3496.55	170.54	64.07
13	1263.27	1085.38	3063.57	173.89	56.69
14	1263.27	1087.78	9630.90	171.49	171.63
15	1259.99	1086.63	6812.75	169.36	118.12
16	1259.96	1085.84	4813.86	170.12	82.47
17	1259.96	1085.23	1869.02	170.73	1.00
18	1261.28	1088.36	11075.72	168.91	194.69
19	1269.33	1087.51	8917.12	177.82	165.54
20	1290.57	0.00	0.00	0.00	0.00
21	1322.16	1085.89	4927.88	232.27	108.60
22	1362.40	0.00	0.00	0.00	0.00
23	1370.74	1085.29	2340.21	281.45	66.07
24	1375.56	1087.09	7917.64	284.47	175.03
25	1376.13	1090.56	16463.88	281.56	360.00
26	1374.46	1090.35	15951.25	280.11	353.54
27	1372.42	1091.33	18382.71	277.09	360.00
28	1370.14	1090.21	15605.44	275.93	345.86
29	1367.21	1091.52	18846.99	271.69	360.00
30	1363.36	1091.80	19518.34	267.56	360.00
31	1340.45	1093.00	22631.66	243.45	360.00
32	1332.03	1092.48	21240.13	235.55	360.00
33	1323.10	1092.16	20404.74	226.94	360.00
34	1314.14	1091.31	18347.46	218.83	360.00
35	1306.20	1089.54	13998.54	212.66	307.85
36	1297.52	1090.16	15488.32	203.36	330.46

SYSTEM TOTAL POWER GENERATED IN M.W

756.73	815.29	707.27	704.63	637.31	546.90
712.68	578.18	454.19	649.88	666.58	464.46
359.46	681.58	693.24	822.19	731.69	706.56
709.51	547.03	494.46	428.66	602.56	859.16
1167.66	1220.80	1219.15	1148.75	1104.34	1088.46
1019.23	994.01	919.19	867.46	927.15	855.54

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY YEAR 1

NODE	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	4100000.	10613391.	0.	0.	95582.	0.	4496980.	0.
2	5350000.	4078362.	0.	0.	150552.	0.	1626923.	0.
3	0.	-129369.	11661699.	523788.	0.	606281.	0.	12156406.
4	0.	5211541.	0.	0.	0.	0.	0.	0.
5	0.	0.	9024909.	0.	0.	0.	0.	9024926.
6	0.	2704847.	6293099.	212496.	0.	0.	0.	6505612.
7	0.	1998152.	0.	0.	0.	0.	0.	0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY YEAR 2

NODE	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	4496980.	10955440.	0.	0.	96465.	0.	4274023.	0.
2	1626923.	5196534.	0.	0.	125112.	0.	1840755.	0.
3	0.	549971.	10324673.	1831713.	0.	111833.	0.	12156406.
4	0.	5484766.	0.	0.	0.	0.	0.	0.
5	0.	0.	9024909.	0.	0.	0.	0.	9024926.
6	0.	2407032.	6456549.	49046.	0.	0.	0.	6505612.
7	0.	1536673.	0.	0.	0.	0.	0.	0.

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 1

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	4100000.	10613391.	0.	0.	95582.	0.	4496980.	0.
2	4496980.	10955440.	0.	0.	96465.	0.	4274023.	0.
PERIOD TOTALS		21568832	0	0	192047	0		0
PERIOD AVERAGES		10784416	0	0	96023	0		0

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 2

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	5350000.	4078362.	0.	0.	150552.	0.	1626923.	0.
2	1626923.	5194534.	0.	0.	125112.	0.	1840755.	0.
PERIOD TOTALS		9274896	0	0	275664	0		0
PERIOD AVERAGES		4637448	0	0	137832	0		0

OUTPUT

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 3

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	0.	-129369.	11661699.	523788.	0.	606281.	0.	12156406.
2	0.	549971.	10324673.	1831713.	0.	111833.	0.	12156406.
PERIOD TOTALS		420602	21986372	2355501	0	718114		24312812
PERIOD AVERAGES		210301	10993186	1177750	0	359057		12156406

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 4

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	0.	5211541.	0.	0.	0.	0.	0.	0.
2	0.	5484766.	0.	0.	0.	0.	0.	0.
PERIOD TOTALS		10696307	0	0	0	0		0
PERIOD AVERAGES		5348153	0	0	0	0		0

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 5

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	0.	0.	9024909.	0.	0.	0.	0.	9024926.
2	0.	0.	9024909.	0.	0.	0.	0.	9024926.
PERIOD TOTALS		0	18049818	0	0	0		18049852
PERIOD AVERAGES		0	9024909	0	0	0		9024926

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 6

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	0.	2704847.	6293099.	212496.	0.	0.	0.	6505612.
2	0.	2407032.	6456549.	49046.	0.	0.	0.	6505612.
PERIOD TOTALS		5111879	12749648	261542	0	0		-13011224
PERIOD AVERAGES		2555939	6374824	130771	0	0		6505612

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY NODE 7

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	0.	1998152.	0.	0.	0.	0.	0.	0.
2	0.	1536673.	0.	0.	0.	0.	0.	0.
PERIOD TOTALS		3534825	0	0	0	0		0
PERIOD AVERAGES		1767412	0	0	0	0		0

SYSTEM OPERATION STUDY BY N . I . H .

SIMULATION PERIOD TOTAL SUMMARY BY YEAR 100000

YEAR	START. STRG.	UNREG. FLOW	DEMANDS	SHORTAGES	EVAPORATION	SYSTEM LOSS	ENDING STRG.	AC.DEMAND
1	9450000.	24476926.	26979708.	736284.	246134.	606281.	6123903.	27686944.
2	6123903.	26130418.	25806132.	1880759.	221577.	111833.	6114778.	27686944.
PERIOD TOTALS		50607344	52785840	2617043	467711	718114		55373888
PERIOD AVERAGES		25303672	26392920	1308521	233855	359057		27686944

SYSTEM OPERATION STUDY BY N . I . H .
SIMULATION PERIOD AVERAGE 10-DAILY FLOWS

LINK NO / EASON NO	1	2	3	4	5	6	7
1	946	19248	5360	5444	10618	13894	859
2	1663	20434	6546	0	17949	19273	0
3	1932	20284	6394	0	20076	21906	0
4	893	20399	6510	1487	15205	17736	928
5	1791	18887	4999	0	15358	17537	0
6	1705	13499	2388	0	11913	12591	0
7	1154	23712	9823	3232	9748	10145	1254
8	2441	17306	3418	0	12848	13989	0
9	4046	19076	3798	0	12014	14396	0
10	4498	21902	8013	1760	12258	14800	0

11	5310	23437	9549	1612	11514	13330	1299
12	7341	17430	3540	4563	9639	12540	186
13	5941	17100	3212	2870	9696	11933	3062
14	7706	22173	8284	247	13868	14694	468
15	8226	28545	13268	2361	11159	11631	2228
16	8332	34091	20201	10406	5502	6968	2124
17	8332	32128	18239	7938	5724	7098	3086
18	8332	22940	9052	0	12473	16964	9836
19	8332	22455	8566	0	10557	16063	10226
20	8332	17662	3773	2725	0	15125	16733
21	8332	17147	1870	899	3011	14046	22821
22	8332	14151	263	3860	0	12742	24087
23	8332	15615	1727	1443	1300	10466	13658
24	8332	21652	6375	0	9909	14475	7611
25	8332	23116	9228	0	17070	17711	2154
26	7598	25360	11471	0	16821	17261	357
27	5979	26786	12897	0	19110	19140	0
28	4435	24480	10590	0	17905	18752	0
29	3061	23259	9371	0	20887	20437	0
30	3127	25320	10042	0	23086	22580	0
31	2955	22770	8881	0	24322	24637	0
32	2420	22442	8553	0	21607	22145	0
33	2170	20295	6406	0	21386	22319	0
34	2034	17607	3718	0	18445	21580	0
35	1897	20190	6302	0	13476	13965	0
36	1972	17529	2252	129	16858	17442	0

SYSTFM OFERATION STUDY BY N . I . H .
SIMULATION PERIOD MAXIMUM 10-DAILY FLOWS

LINK NO EASON NO	1	2	3	4	5	6	7
1	17038	221483	96483	70766	164179	199588	15465
2	15613	185246	60247	0	208420	216140	0
3	17887	190027	65027	0	239128	248482	0
4	16077	189297	64297	26780	204502	221388	16705
5	16180	177207	52207	0	191669	211859	0
6	16192	131217	31217	0	151185	150548	0
7	20784	251433	126433	58192	155731	161521	22582
8	23961	167396	42396	0	158995	161523	0
9	43532	186026	48526	0	165647	167432	0
10	44708	200540	75540	31682	142213	156438	0
11	50358	230627	105627	29030	138689	155605	23382
12	74999	168665	43665	82137	138548	156752	3349
13	65061	182823	57824	51665	143918	156550	55127
14	74999	209220	84220	4458	153327	152616	8430
15	74999	259595	122095	36261	125930	121996	40117
16	74999	308287	183288	100749	50913	62799	24753
17	74999	325992	200993	102968	84359	109596	50067
18	74999	216043	91044	0	113766	167402	102000
19	74999	209274	84274	0	100884	158260	118722
20	74999	192925	67925	49059	0	222047	183578
21	74999	171170	33670	16198	54206	133346	259316
22	74999	129734	4735	69492	0	130672	219475
23	74999	156095	31096	25986	23402	106169	163954
24	74999	212549	75049	0	91278	137888	72646
25	74999	225518	100518	0	164638	160521	22458
26	74999	243282	118282	0	159512	157694	6428
27	55266	241473	116473	0	183827	182218	0
28	43502	227056	102056	0	166257	172164	0
29	31760	215365	90366	0	188469	185374	0
30	28684	236846	99347	0	214701	208205	0
31	30460	217177	92177	0	276316	231576	0
32	22687	217179	92179	0	212401	214022	0
33	19798	199121	74122	0	204047	212065	0

34	18562	163661	38661	0	183474	210344	0
35	17215	187773	62773	0	139985	135445	0
36	18511	178052	40553	2337	170371	157268	0

3.0 RECOMMENDATIONS

PISIM-I is oriented towards the analysis of complex river basin water management problem by those individuals who are closely associated with these problems, the actual planners and managers of water resources. Even though it is a long term water management model, it could be used to evaluate the impact of alterantive plannings although it will not select a specific plan. It requires the complete understanding of the various system elements by the decision maker.

The model described here is capable of simulating water storage, transport,power potential and distribution morphology of a river basin system through the Out-of-Kilter Algorithm to find out the local optimal solution for each time period. However, irrigation is considered primary and power as secondary. Since energy production is fast becoming one of the important political and economical issues and also hydropower is inexpensive and pollutant-free, the option of power release as primary either throughout the simulation period or some periods of the year may be considered in further studies.

In this model ten-daily demand is to be supplied by the user to decide upon the releases. Here it is recommended that future efforts may be devoted to the study of the possibility of expanding the irrigation sector of the model to include crop water requirements,perhaps based on evapotranspiration prediction.

4.0 ACKNOWLEDGEMENTS

The study was conducted through the intensive use of Texas Water Development Board river basin simulation Model SIMYLD and adopting their optimization alogrithm. The 'reservoir factor' used in this study is conceived through the discussions and publications of Bhakra Beas Management Board, Nangal. The use of variable maximum storage capacity in reservoir operation model was inspired by the Irrigation Department,Govt. of Gujarat. Acknowledgements and thankfulness are due to the above three agencies.

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