V.3.3-RES-SNGL-SPEC-INDSRCHGE SINGLE RESERVOIR REGULATION OPERATION SCHEME INDUCED SURCHARGE

Purpose

Scheme INDSRCHGE is used during flood situations to provide additional storage above normal top of pool level.

Many reservoirs are operated in the induced surcharge mode of operation during flood periods. In this mode, all spillway gates are raised uniformly to permit water to flow between the spillway crest and the bottom of the spillway gates. This permits the reduction of peak discharge from the dam by using reservoir storage above the normal elevation of the top of gates.

The induced surcharge curves are developed from past floods by the agency operating the dam. The curves show a relationship between pool elevation (SCEL), COMPINQ-hour average inflow (SCQI) for a specified previous time unit (COMPINQ) and outflow (SCQO) for the next time step. The curves are applicable only during periods when the pool elevation is rising. When the elevation starts to fall, other relations are used to evacuate the induced-surcharge storage.

Separate induced surcharge curves and evacuation instructions may be used for winter and summer. In this case, two sets of surcharge curves and two sets of evacuation instructions will have to be input.

When the pool starts to fall a variety of instructions are used. Generally the first step is to keep the same gate openings at peak pool (or keep the same peak outflow) until the storage is evacuated to a designated pool elevation (or rule curve elevation). If further evacuation is needed, additional instructions are used to bring the pool down to normal level.

Outflows from keeping the same gate settings can be determined by means of a three-way relation between pool elevation, gate openings and total discharge (including generation or sluice discharge). Gate openings are assumed to be the same for all gates.

Ten evacuation options are provided in the scheme. The evacuation option will be dependent on one of the following five data types:

1. Pool elevation
2. Peak outflow reached in a surcharge-evacuation cycle
3. Peak pool elevation reached in a surcharge-evacuation cycle
4. Pool elevation and peak outflow reached in a surcharge-evacuation cycle
5. Peak pool elevation and peak outflow reached in a surcharge-evacuation cycle

A surcharge-evacuation cycle begins when a reservoir first time becomes surcharged and ends when the surged pool is evacuated to the normal operation level. One or more surcharge and evacuation processes may occur in a surcharge-evacuation cycle. One or more surcharge-evacuation cycles are possible in a RES-SNGL run. Peak

pool elevation and peak outflow are the peak values occurred in a surcharge-evacuation cycle. Any surcharge-evacuation operations after a completed cycle is treated as a new cycle and the peak pool elevation and outflow are to be determined from fresh start. A decision table (input by the user) based on exceedance criteria of the selected data types will determine which of the following evacuation options will be in effect in a surcharge-evacuation cycle:

1. The maximum gate setting (at peak pool) is maintained until the pool drops to HTARGET1 if peak outflow is greater than PEAKQO1, otherwise, drops the pool to HTARGET2. HTARGET1 and HTARGET2 are specified or rule curve elevation (or rule curve plus a specified addition).

2. The peak outflow is maintained until the pool drops to HTARGET1 if peak outflow is greater than PEAKQO1, otherwise, drops the pool to HTARGET2. HTARGET1 and HTARGET2 are specified or rule curve elevations (or rule curve plus a specified addition).

3. a. The maximum gate setting (at peak pool) is maintained until the COMPINQ-hour average inflow is specified amount (DIFFQI1) less than the outflow, then pass COMPINQ-hour average inflow plus the specified amount (DIFFQI1) until outflow equals to a specified value (QTARGET1).

   b. The outflow is then reduced at a specified rate per hour (REDUCE) until:
      (1) Outflow reaches a specified value (QTARGET2),
      (2) Pool drops to a specified elevation (HEVACEND) or
      (3) COMPINQ-hour average inflow is a specified amount (DIFFQI3) less than outflow.

      If (1) is reached first, continue to discharge QTARGET2 until the specified elevation (HEVACEND) is reached then revert to normal operation. If (2) is reached first, revert to normal operation. If (3) is reached first, continue to discharge COMPINQ-hour average inflow plus DIFFQI3 until outflow reaches QTARGET2 then follow (1) or (2)

4. a. The peak outflow is maintained until the outflow is a specified amount (DIFFQI1) greater than the COMPINQ-hour average inflow.

   b. Same as 3b.

5. Option 5 is a combination of options 1 and 3b.

6. Option 6 is a combination of options 2 and 3b.

7. Option 7 is the same as option 3b.

8. If peak outflow is more than twice as large as the COMPINQ-hour average inflow, begin reducing outflow by a specified rate per hour (REDUCE1). When the outflow falls below a specified value (QTARGET3), reduce outflow by a specified rate per hour (REDUCE2). When the outflow decreases to a value that is, at

most, a specified amount (DIFFQI2) greater than the COMPINQ-hour average inflow and the pool is below a specified elevation (HTARGET3), then continue with option 3b; Otherwise, Outflow is reduced to a specified discharge (QTARGET1) or to COMPINQ-hour average plus a specified addition (DIFFQI2), whichever is greater. After outflow drops to the specified discharge (QTARGET1), then continue with option 3b.

9. Option 9 is a combination of options 1 and 8.

10. Option 10 is a combination of options 2 and 8.

Input Summary

Keyword	Definition and Format
INDSRCHGE 1/	Input opening keyword for scheme
PARMS	Parameter opening keyword for scheme
[HRSCHECK]	Time interval for checking surcharge tables: - integer - value must be <= Operation data time interval S value must be an evenly divisible into Operation data time interval - defaults to Operation data time interval
HUPPER	Upper top of power/conservation pool. Release QGENMAX if pool elevation is above HLOWER (HCHECK, if entered) and below HUPPER. Release up to MINSCQO by passing inflow, if pool elevation is at HUPPER. Follow surcharge schedule above HUPPER unless a special discharge rule is desired via HCHECK. HUPPER may be specified in numeric, RULE or RULE±factor (no spaces between RULE, ± and factor): Numeric - real value within ELVSSTOR curve or [RULE] - use values from rule curve [RULE]±factor - values are factor above/below rule curve
HLOWER	Lower top of power/conservation pool. Release QGENMAX if pool elevation is above HLOWER and below HUPPER (HCHECK, if entered). Release up to QGENMAX by passing inflow if pool elevation is at HLOWER. Follow normal operation procedure if pool is below HLOWER. HLOWER may be specified in numeric, RULE or RULE±factor (no spaces between RULE, ± and factor): Numeric - real value within ELVSSTOR curve or [RULE] - use values from rule curve [RULE]±factor - values are factor above/below rule curve

Keyword	Definition and Format
[QGENMAX]	Power plant capacity or channel capacity below dam. Release QGENMAX if pool elevation is above HLOWER and below HUPPER (HCHECK, if entered). Defaults to MINSCQO: - value must be real and positive
[HCHECK]	Omit if hourly rate of rise of pool is used (SCQI(m) <= 10.0). Checking elevation to use special discharge rule during increasing COMPINQ-hour average inflows. Defaults to HUPPER. Release QGENMAX if pool elevation is above HLOWER and is less than or equal to HCHECK. If pool elevation is above HCHECK and COMPINQ-hour average inflow is between QCHECK and MINSCQO begin making a discharge that is DIFFQ less than COMPINQ-hour average inflow. If COMPINQ-hour average inflows rise above MINSCQO, follow the surcharge schedule. HCHECK may be specified in numeric, RULE or RULE±factor (no spaces between RULE, ± and factor): Numeric - real value within ELVSSTOR curve or [RULE] - use values from rule curve [RULE]±factor - values are factor above/below rule curve
[QCHECK]	Omit if hourly rate of rise of pool is used (SCQI(m) <= 10.0). Checking discharge to use special discharge rule during increasing COMPINQ-hour average inflows. If pool elevation is above HCHECK and COMPINQ-hour average inflow is between QCHECK and MINSCQO, begin making a discharge that is DIFFQ less than COMPINQ-hour average inflow If COMPINQ-hour average inflows rise above MINSCQO, follow the surcharge schedule. Defaults to MINSCQO.
[QDIFF]	Omit if hourly rate of rise of pool is used (SCQI(m) <= 10.0). If pool elevation is above HCHECK and COMPINQ-hour average inflow is between QCHECK and MINSCQO, begin making a discharge that is DIFFQ less than COMPINQ-hour average inflow. If COMPINQ-hour average inflows rise above MINSCQO, follow the surcharge schedule. Defaults to zero.
[COMPINQ]	Omit if hourly rate of rise of pool is used (SCQI(m) <= 10.0). Integer time interval in hours (1 < value <= Operation data time interval) for computing average inflow from the preceding COMPINQ-hour inflows. The average COMPINQ-hour inflow is used in the surcharge curve lookup during surcharge operation. Defaults to Operation data time interval.

Keyword	Definition and Format
SCQI	'm' values (maximum 25) of inflow or hourly rate of rise of pool elevation in surcharge curve: - COMPINQ-hour average inflow, if SCQI(m) > 10.0 - hourly rate of rise of pool elevation, if SCQI(m) <= 10.0 - real, positive values - values in ascending order
SCEL	'n' values (maximum 25) of elevation in surcharge curve: - real - values within ELVSSTOR curve 2/ - values in ascending order
SCQO	'n x m' values (maximum 625) of discharge in surcharge curve: 3/ - real, positive values - each set of 'n' values must be in ascending order
[MINSCQO]	Lowest COMPINQ-hour average inflow for surcharge computation using surcharge curve. Surcharge curve below MINSCQO will be ignored during surcharge computation. Defaults to SCQI(1), the lowest COMPINQ-hour average inflow value in the surcharge curve, if SCQI(m) >10.0. Set MINSCQO=0, if hourly rate of rise of pool elevation is used (SCQI(m) <= 10.0). - value must be real and positive - SCQI(1) <= MINSCQO
[MINSCQO]	Lowest outflow from surcharge computation using surcharge curve. Surcharge curve below MINSCQO will be ignored during surcharge computation. Defaults to SCQO(1), the lowest outflow value in the surcharge curve: - value must be real and positive - SCQO(1) $\leq$ MINSCQO
[CONV]	Iteration criterion for determining induced surcharge release: - value must be between 0.01 and 1.0 - defaults to 0.02
DTYPE	DTYPE specifies types of data to be used in DTABLE in specifying method to evacuate a surcharged reservoir under different surcharge condition. DTYPE indicates one of the following data types is used in DTABLE: - pool elevation - peak outflow - peak pool elevation - pool elevation and peak outflow - peak pool elevation and peak outflow

Keyword	Definition and Format
DTABLE	Decision table includes lists (maximum 10) of one or more evacuation options to be used to evacuate a surcharged reservoir under different surcharge condition. Based on the exceedance criteria of DTYPE data, the DTABLE determines which one of the evacuation options in the list is in effect. For DTYPE = 1, 2 or 3: - number of values (maximum 20) in table must be multiple of 2 - odd values are pool elevation or peak outflow or peak pool elevation depending on DTYPE and must be monotonically increasing - even values must be integer and range from 1-10 (these are the evacuation options) - for DTYPE = 1 and 3, odd values must be within ELVSSTOR curve For DTYPE = 4 or 5: - number of values (maximum 30) in table must be multiple of 3 - every 1st value (i.e., 1, 4, 7...) is either pool elevation or peak pool elevation and must be within ELVSSTOR curve and monotonically increasing - every 2nd value (i.e., 2 ,5 ,8...) is peak outflow and must be monotonically increasing - every 3rd value (i.e., 3, 6, 9...) must be integer and range from 1-10 (these are the evacuation options)
[HPREVQ]	Elevation to use previous outflow during evacuation periods. Defaults to HLOWER. If at any elevation above HPREVQ, the COMPINQ-hour average inflow value exceeds the outflow value then discharge the same outflow as previous time step and continue until COMPINQ-hour average inflow is less than outflow. HPREVQ may be specified in numeric, RULE or RULE±factor (no spaces between RULE, ± and factor): Numeric - real value within ELVSSTOR curve or [RULE] - use values from rule curve [RULE]±factor - values are factor above/below rule curve
[HEVACEND]	Stop evacuation operation and resume normal operation if falling pool reaches HEVACEND. Defaults to HLOWER. HEVACEND may be specified in numeric, RULE or RULE±factor (no spaces between RULE, ± and factor): Numeric - real value within ELVSSTOR curve or [RULE] - use values from rule curve [RULE]±factor - values are factor above/below rule curve

Keyword	Definition and Format

The following evacuation parameters are needed depending on the evacuation options chosen in the DTABLE:

[HTARGET1] Target elevation #1:
- for evacuation options 1, 2, 5, 6, 9 and 10 if peak outflow is greater than PEAKQO1
- if numeric:
  real value within ELVSSTOR curve
- if rule curve usage desired:
  enter as RULE or RULE±factor (no spaces between RULE, ± and factor)

[HTARGET2] Target elevation #2. Defaults to HTARGET1:
- for evacuation options 1, 2, 5, 6, 9 and 10 if peak outflow is greater than or equal to PEAKQO1
- if numeric:
  real value within ELVSSTOR curve
- if rule curve usage desired:
  enter as RULE or RULE±factor (no spaces between RULE, ± and factor)

[HTARGET3] Target elevation #3:
- for evacuation options 8, 9 and 10
- if numeric:
  real value within ELVSSTOR curve
- if rule curve usage desired:
  enter as RULE or RULE±factor (no spaces between RULE, ± and factor)

[REDUCE] Specified hourly discharge rate for reducing outflow:
- for evacuation option 3b, 4, 5, 6, 7, 8, 9 and 10
- value must be real and positive

[REDUCE1] Specified hourly discharge rate for reducing outflow #1:
- for evacuation option 8, 9 and 10
- value must be real and positive

[REDUCE2] Specified hourly discharge rate for reducing outflow #2:
- for evacuation option 8, 9 and 10
- value must be real and positive

[QTARGET1] Target evacuation discharge #1:
- for evacuation option 3a, 8, 9 and 10
- value must be real and positive

[QTARGET2] Target evacuation discharge #2:
- for evacuation option 3b, 4, 5, 6, 7, 8, 9 and 10
- value must be real and positive

Keyword	Definition and Format
[QTARGET3]	Target evacuation discharge #3: - for evacuation option 8, 9 and 10 - value must be real and positive
[DIFFQI1]	Inflow addition/subtraction #1: - for evacuation options 3a and 4a - value must be real and positive
[DIFFQI2]	Inflow addition/subtraction #2: - for evacuation option 8, 9 and 10 - value must be real and positive
[DIFFQI3]	Inflow addition/subtraction #3: - for evacuation option 3b, 4, 5, 6, 7, 8, 9 and 10 - value must be real and positive
[PEAKQO1]	Peak outflow #1 used for selecting HTARGET1 or HTARGET2 during evacuation. Defaults to zero and therefore always use HTARGET1: - for evacuation options 1, 2, 5, 6, 9 and 10. Use HTARGET1 if peak outflow is greater than PEAKQO1, otherwise, use HTARGET2 - value must be real and positive

The following 4 gate parameters are used during increasing COMPINQ-hour average inflow when IOPTND equals to 1 and in evacuation options 1, 3a, 5 and 9.

[GATEOPEN]	'm' values (maximum 25) of gate openings: - real, positive values represent vertical distance of lower edge of gate above gate seals - values must be in ascending order
[GATEL]	'n' values (maximum 25) of elevations: - real - values within ELVSSTOR curve - values must be in ascending order
[GATEQ]	'n x m' values (maximum 625) of discharge: 4/ - real, positive values - each set of 'n' values must be in ascending order
[GATESET]	Time interval for checking surcharge tables and resetting gates (must be equal to HRSCHECK): - integer - value must be ≤ Operation data time interval - value must be an evenly divisible into Operation data time interval - defaults to Operation data time interval
[IOPTND]	Option for maintaining gate opening during rising

Keyword	Definition and Format
	pool or increasing COMPINQ-hour average inflow in a surcharged reservoir: - integer - 0 = follow surcharge curve in surcharge operation - 1 = maintain gate opening even though the surcharge relation indicates a decrease - defaults to 1 if gate curve is available - defaults to 0 if gate curve is not available
[CURVE]	Rule curve definition (needed only if RULE or RULE ± factor was specified for HCHECK, HUPPER, HLOWER, HTARGET1, HTARGET2 or HTARGET3). If defined here: - 'j' dates (maximum 50) followed by 'j' values (maximum 50) of elevation - dates: - integer - ascending order - between 1 and 366 - elevations: - real - within ELVSSTOR curve If referenced to original definition: - name and level number of scheme in which it was originally defined
[RULETIME]	Time of day rule curve is set: - needed only if CURVE is defined in this scheme - integer - between 0 and 24, inclusive
ENDPARMS	Parameter ending keyword for scheme.
[CARRYOVER]	Carryover opening keyword for scheme. - needed only if carryover is entered
[BACKQI]	Instantaneous inflow 2 periods prior to start of run: - real, positive value - defaults to general inflow carryover value
[BACKPOOL]	Pool elevation 2 periods prior to start of run: - real, positive value - defaults to general pool elevation carryover value
[TENDENCY]	Pool tendency to indicate a reservoir is surcharging or evacuating: - real (positive for surcharging, negative for evacuating) - defaults to missing value. Pool tendency will be computed in the program

[MAXEL]	Peak elevation reached in surcharge operation: - real - value within ELVSSTOR curve - defaults to -999.0 (indicates reservoir is not surcharged at the start of the run)
[QMAXEL]	Discharge at peak elevation MAXEL: - real, positive value - defaults to -999.0 (indicates reservoir is not surcharged at the start of the run)
[QMAX]	Peak discharge reached in surcharge operation: - real, positive value - defaults to -999.0 (indicates reservoir is not surcharged at the start of the run)
[ENDCO]	Carryover ending keyword for scheme: - needed only if CO was specified
ENDINDS	Input ending keyword for scheme

Notes:

1/ No time series are needed for this scheme.

2/ ELVSSTOR is the elevation versus storage curve defined in the general parameter section.

3/ The discharge values are input in the following order: discharges at each of the 'n' ascending elevations for inflow 1, followed by discharges at each of the 'n' elevations for inflow 2, etc.

4/ The discharge values are input in the following order: discharges at each of the 'n' ascending elevations for gate opening 1, followed by discharges at each of the 'n' elevations for gate opening 2, etc.

An example of emergency flood regulation schedule for George Reservoir follows. An input file including required parameters and decision table is also attached. In this example, the evacuation option is dependent on the peak outflow.

Excerpt from George Reservoir Regulation Manual (February 1993)

Emergency Flood Regulation Schedule for Power Plant Operators

Note: Elevation in parentheses are for May thru November, all other elevations are year round values.

I Increasing 3-hour Average Inflows

Note: During increasing 3-hour average inflows, except for condition I.B, if the discharge value taken from the induced surcharge

table is less than the previous hour's discharge, maintain the previous hour's value.

A. Check surcharge tables each hour (HRSCHECK). If pool level (> HCHECK) and 3-hour average inflow (> MINSCQI) require a release, commence making combined powerhouse and spillway releases that are equal to that required by the surcharge.

B. If the pool elevation is above 189.0 feet (HCHECK) and the 3-hour average inflow is between 40,000 cfs (QCHECK) and 50,000 cfs (MINSCQI), begin making a discharge that is 8,000 cfs (QDIFF) less than the 3-hour average inflow. If 3-hour average inflows rise above 50,000 cfs (MINSCQI), follow the surcharge schedule.

II Emptying Instructions

Note: After emptying operation commences, if the 3-hour average inflow increase sufficiently to exceed outflow follow instructions in I.A or I.B above, whichever is applicable. If at any elevation above 189.5 feet (HPREVQ), the 3-hour average inflow value exceeds the outflow value then discharge the previous outflow and continue until 3-hour average inflow is less than outflow. If outflow reaches powerhouse capacity (QTARGET2 = 26,000 cfs) while pool is above 188.5 (189.5) feet (HEVACEND), then maintain an outflow of 26,000 cfs (QTARGET2) until pool falls to elevation 188.5 (189.5) feet (HEVACEND). When elevation 188.5 (189.5) feet (HEVACEND) is reached revert to normal operation.

A. DTYPE = 2 (data type is peak outflow), evacuation option = 10:
If peak outflow as determined by induced surcharge schedule is equal to or greater than 125,000 cfs (DTABLE(3,1)),
Option 2: maintain peak outflow until pool falls below 191 feet (HTARGET1),

Option 8: If peak outflow is more than twice as large as the 3-hour average inflow, begin reducing outflow by 5,000 cfs per hour (REDUCE1). When the outflow falls below 70,000 cfs (QTARGET3) reduce outflow by 2,000 cfs per hour (REDUCE2), when the outflow decreases to a value that is, at most, 10,000 cfs (DIFFQI2) greater than the 3-hour average inflow and the pool is below 189 (190.5) feet (HTARGET3),
Option 3b: begin reducing outflow at rate of 1,000 cfs per hour (REDUCE) until the pool falls to 188.5 (189.5) feet (HEVACEND). (More constraints are given in Note above)

Otherwise, reduce outflow to 65,000 cfs (QTARGET1) or to 3-hour average inflow plus 10,000cfs (DIFFQI2) whichever is greater. If this results in an outflow greater than 65,000 cfs (QTARGET1), continue passing 3-hour average inflow plus 10,000 cfs (DIFFQI2) until outflow reaches 65,000 cfs (QTARGET1). When outflow reaches 65,000 cfs (QTARGET1),
Option 3b: begin reducing outflow at rate of 1,000

cfs per hour (REDUCE) until the pool falls to 188.5 (189.5) feet (HEVACEND). (More constraints are given in Note above)

B. DTYPE = 2 (data type is peak outflow), evacuation option = 10:
If peak outflow as determined by induced surcharge schedule is less than 125,000 cfs but greater than 65,000 cfs (DTABLE(2,1)),
Option 2: maintain peak outflow until pool falls below 190 feet (HTARGET2),

Option 8: If peak outflow is more than twice as large as the 3-hour average inflow, begin reducing outflow by 5,000 cfs per hour (REDUCE1). When the outflow falls below 70,000 cfs (QTARGET3) reduce outflow by 2,000 cfs per hour (REDUCE2), when the outflow decreases to a value that is, at most, 10,000 cfs (DIFFQI2) greater than the 3-hour average inflow and the pool is below 189 (190.5) feet (HTARGET3),
Option 3b: begin reducing outflow at rate of 1,000 cfs per hour (REDUCE) until the pool falls to 188.5 (189.5) feet (HEVACEND). (More constraints are given in Note above)
Otherwise, reduce outflow to 65,000 cfs (QTARGET1) or to 3-hour average inflow plus 10,000cfs (DIFFQI2) whichever is greater. If this results in an outflow greater than 65,000 cfs (QTARGET1), continue passing 3-hour average inflow plus 10,000 cfs (DIFFQI2) until outflow reaches 65,000 cfs (QTARGET1). When outflow reaches 65,000 cfs,
` Option 3b: begin reducing outflow at rate of 1,000 cfs per hour (REDUCE) until the pool falls to 188.5 (189.5) feet (HEVACEND). (More constraints are given in Note above)

C. DTYPE = 2 (data type is peak outflow), evacuation option = 6:
If peak outflow as determined by induced surcharge schedule is less than 65,000 cfs (DTABLE(1,1)),
Option 2: maintain peak outflow until pool falls below 190 feet (HTARGET2), if pool is already below 190 feet (HTARGET2) continue passing peak outflow until pool begins to drop.
Option 3b: Then reduce outflow at rate of 1,000 cfs per hour (REDUCE) until the pool falls to 188.5 (189.5) feet (HEVACEND). (More constraints are given in Note above)

Parameter Input Example for INDSRCHGE Scheme:

```
INDSRCHGE(1)          $for December through April operation
PARMS
HRSCHECK   1
HUPPER    189.0
HLOWER    189.0
HCHECK    189.0
QCHECK    40000.
QDIFF     8000.
```

```
COMPINQ     3
SCQI            50000.00   60000.82   70000.75   80000.87    90001.00  &
               100001.18  120001.44  140001.69  160001.89   180002.13  &
               200002.44  300003.75  400005.19  600007.94   800010.75
SCEL              188.30     189.00     190.00     191.00      192.00  &
                  194.00     196.00     198.00     200.00
SCQO            30000.00   35000.48   42000.58   55000.76    75000.81  &
               115501.37  158001.73  207002.44  265003.31   &
                35000.48    39000.54   46500.64  56000.77    75000.81  &
               115501.37  158001.73  207002.44  265003.31   &
                39500.54   43000.59   51000.70   60000.82    75000.81  &
               115501.37  158001.73  207002.44  265003.31   &
                43500.60   47500.65   55000.76   65000.89    76000.81  &
               115501.37  158001.73  207002.44  265003.31   &
                47500.65   51500.71   59000.81   68500.75    79500.87  &
               115501.37  158001.73  207002.44  265003.31   &
                52000.71   55500.76   63500.87   73000.80    83500.94  &
               115501.37  158001.73  207002.44  265003.31   &
                58000.80   62000.85   71000.75   80000.87    90001.00  &
               115501.37  158001.73  207002.44  265003.31   &
                67000.69   70500.75   79000.87   87001.00    96501.13  &
               119001.44  158001.73  207002.44  265003.31   &
                76500.81   80000.87   87001.00   94001.06   101501.19  &
               121001.44  158001.73  207002.44  265003.31   &
                97501.12   97501.12   97501.12  102001.19   107001.25  &
               124001.50  160001.89  207002.44  265003.31   &
               107001.25  107001.25  107001.25  109001.31   112001.31  &
               129001.56  164001.88  207002.44  265003.31   &
               132001.63  132001.63  132001.63  138001.69   140501.69  &
               153501.69  183002.13  220002.69  268003.31   &
               167001.88  167001.88  167001.88  168002.00   170002.00  &
               182002.13  230002.75  244003.00  290003.69   &
               218002.69  218002.69  218002.69  221002.63   224502.69  &
               243003.00  270003.31  315004.00  403005.19   &
               260003.20  260003.20  260003.20  271503.38   285003.56  &
               321004.13  372004.75  440005.75  500006.50
MINSCQI  50000.
MINSCQO  30000.
CONV  .020
DTYPE   2
DTABLE          .00     6                                              &
          65000.89    10                                              &
         125001.50    10
HPREVQ     189.5
HEVACEND   188.5
HTARGET1   191.0
HTARGET2   190.0
HTARGET3   189.0
REDUCE      1000.01
REDUCE1     5000.01
REDUCE2     2000.01
QTARGET1    65000.89
QTARGET2    26000.44
QTARGET3    70000.44
DIFFQI1     0.0
DIFFQI2    10000.14
DIFFQI3          .00
PEAKQO1    125000.0
ENDP
ENDINDS
INDSRCHGE(2)          $for May through November operation
PARMS
HRSCHECK   1
HUPPER    189.0
HLOWER    189.0
HCHECK    189.0
QCHECK    40000.
QDIFF     8000.
```

```
COMPINQ     3
SCQI           50000.00   60000.82   70000.75   80000.87    90001.00  &
              100001.18  120001.44  140001.69  160001.89   180002.13  &
              200002.44  300003.75  400005.19  600007.94   800010.75
SCEL              188.30     189.00     190.00     191.00      192.00  &
                  194.00     196.00     198.00     200.00
SCQO            30000.00   35000.48   42000.58   55000.76    75000.81  &
              115501.37  158001.73  207002.44  265003.31    &
              ......... .........   .........  .........   .........  &
              .........  .........  .........  .........    &
              260003.20  260003.20  260003.20  271503.38   285003.56  &
              321004.13  372004.75  440005.75  500006.50
MINSCQI  50000.
MINSCQO  30000.
CONV  .020
DTYPE   2
DTABLE          .00     6                                              &
           65000.89    10                                              &
          125001.50    10
HPREVQ     189.5
HEVACEND   189.5
HTARGET1   191.0
HTARGET2   190.0
HTARGET3   190.5
REDUCE      1000.01
REDUCE1     5000.01
REDUCE2     2000.01
QTARGET1    65000.89
QTARGET2    26000.44
QTARGET3    70000.44
DIFFQI1     0.0
DIFFQI2    10000.14
DIFFQI3         .00
PEAKQO1    125000.0
ENDP
ENDINDS
```

Reservoir Command Language Input Example for INDSRCHGE Scheme:

```
RCL
IF (DAY.LT.121.OR.DAY.GT.335) THEN
  DO ENTERISC(1)
  IF (SURCHARGE) THEN DO INDSRCHGE(1)
  ELSE DO POWERGEN
  ENDIF
ELSE
  DO ENTERISC(2)
  IF (SURCHARGE) THEN DO INDSRCHGE(2)
  ELSE DO POWERGEN
  ENDIF
ENDIF
ENDRCL
```