Purpose

Scheme SPILLWAY is applicable to uncontrolled spillways, sluices and gated spillways when all gates are fully open.

Routing over an uncontrolled spillway is required when the pool elevation exceeds the spillway crest elevation. For a gated spillway, routing is required when inflow exceeds the maximum possible outflow at the elevation (normally about 0.5 feet below the top of close gates) where inflow is passed. Routing through a sluice is required if the water is above the sluice invert and the sluice is uncontrolled or at the elevation where inflow is passed and the discharge capacity of the sluice is exceeded.

Input Summary:

Keyword	Definition and Format
SPILLWAY	Input opening keyword for scheme
PARMS	Parameter opening keyword for scheme
TYPE 1/	Type of spillway: - UNC uncontrolled - GATED gated or Reference to original definition location: - Name and level number of scheme in which the parameters were originally defined 2/

The remaining keywords are needed only if the parameters are being defined here (no reference to a previous definition).

[REPLQ] 3/	Minimum discharges allowed to replace the period ending discharges (usually equal to flood discharge); default is machine maximum
CREST	Spillway crest elevation within ELVSSTOR curve 4/
ELVSQ	Spillway rating curve when all gates are fully open if defined here: - 'j' values of elevation followed by 'j' values of discharge. - Elevations within ELVSSTOR curve in ascending order. If referenced to original definition: - Name and level number of scheme in which it was originally defined.

Keyword	Definition and Format
[INTERP]	Interpolation type for spillway rating curve: - LINEAR linear interpolation - LOG logarithmic interpolation - Default is LINEAR
[PASSEL]	Elevation (usually 0.5 feet below the top of closed gates) within ELVSSTOR curve where inflow is passed (needed only if spillway is gated).
[HEADVSQ]	Differential head between headwater and tailwater versus maximum generation discharge curve (needed only if the maximum generation relation is used). If defined here: - 'j' head values followed by 'j' values of discharge - heads in ascending order If referenced to original definition: - name and level number of scheme in which it was originally defined
[TWCURVE]	Tailwater rating curve name (needed only if the maximum generation relation is used): - 8-character name. S must be defined at Forecast Component level - must match name of any other tailwater rating curve used in Reservoir Operation
[CONV]	Convergence criterion between 0.0 and 1.0; default is 0.02 (needed only if the maximum generation relation is used)
[QGEN]	Constant power generation discharge; default is 0.0 (needed only if the maximum generation relation is not used).
[QSLUICE]	Constant sluiceway discharge; default is 0.0
ENDPARMS	Parameter ending keyword for scheme.
[TIME-SERIES] 5/	Time series opening keyword for scheme. S Needed only if any time series are entered.
[QGEN]	Generation discharge time series: - data time interval = Operation data time interval - Dimensions = L3 - Units = CMSD - Missing values are allowed and defaulted to QGEN value in PARMS input

Keyword	Definition and Format
[QSLUICE]	Non-generation discharge time series: - data time interval = Operation data time interval - Dimensions = L3 - Units = CMSD - Missing values are allowed and defaulted to QSLUICE value in PARMS input
[ENDTS]	Time series ending keyword for scheme. - Needed only if TIME-SERIES was entered
CARRYOVER	Carryover opening keyword for scheme
OLDQ	Initial non-spillway discharge (equals QGEN + QSLUICE)
ENDC0	Carryover ending keyword for scheme
ENDSPWY	Input ending keyword for scheme

Notes:

1/ The FILLSPILL scheme follows the same input format from TYPE through QSLUICE for its parameters.

2/ Format for reference: 'SUID(n)' where n is level of definition of SUID.

3/ For some reservoirs, the Modified Puls Routing Method becomes unstable when the operation time interval is used as the routing time period due to large increases in discharge compared to small increases in storage. A smaller routing step than the operation time interval is generated automatically by the program to prevent routing instability. Peak discharge can occur between the time interval points. Any peak discharges greater than REPLQ will be saved temporarily. At the end of the forecast run, these peak values are assigned to the nearest time intervals to replace the time interval discharges.

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

5/ See 'Time Series Definition' in Section V.3.3-RES-SNGL-SPEC.

Input Example

```
SPILLWAY
PARMS
TYPE GATED
CREST         522.00
ELVSQ               522.00     526.00     530.00     534.00     536.00
                    540.00
                     100.00   24000.00   63000.00  114999.75  144999.69
                  211999.62
INTERP LINEAR
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```
PASSEL     524.0
QGEN         100.0
QSLUICE         100.0
ENDP
CARRYOVER
OLDQ         200.00
ENDCO
ENDSPWY
```

Method:

See Section II.4-RES-SNGL for additional information.

A) If power generation discharge is not effected by tailwater elevation and the routing step is equal to the operation time interval, dt, and
$dt \leq 2(V_2 - V_1)/(QO_2 - QO_1)$.

1. Generate spillway discharge, QS, versus storage-discharge, V + QS * dt/2, curve from elevation versus spillway discharge curve and elevation versus storage curve.

2. Compute $V_2 + \frac{1}{2}QS_2 * dt$ using the continuity equation (Modified Puls Routing Method).

3. Compute spillway discharge from the spillway discharge versus storage-discharge curve.

4. Compute new instantaneous discharge by summing up spillway and nonspillway discharges.

5. Compute mean discharge by averaging instantaneous discharges.

6. Compute new storage using the continuity equation.

7. Compute new pool elevation using the elevation versus storage curve.

B) If power generation discharge is effected by tailwater elevation and the routing step is equal to the operation time interval, dt, and
$dt \leq 2(V_2 - V_1)/(QO_2 - QO_1)$.

1. Generate total discharge versus maximum generation discharge curve from pool elevation versus spillway discharge curve, tailwater elevation versus total discharge curve and differential head, (headwater - tailwater), versus maximum generation curve.

2. Generate spillway discharge versus storage discharge curve as in A1.

3. a) Estimate a total discharge.

   b) Compute maximum generation discharge.

c) Compute new total discharge using procedures A2 - A4.

d) Compute a new maximum generation discharge and repeat 3a thru 3d one more time if necessary.

4. Compute mean discharge, storage and pool elevation as in A5, A6, A7.

C) If $dt > 2(V_2 - V_1)/(QO_2 - QO_1)$, then a smaller routing step is generated automatically by the program and repeat simulation procedures in (A) or (B) for as many times as necessary.

Special cases that exist are as follows:

1. If the SPILLWAY scheme is used with the ADJUST utility and the only observed data specified is pool elevation (OBSH), then for all periods through the last one with observed data, discharges are computed using adjusted pool elevations (equal to observed elevations whenever observed data are available). Spillway routing is not carried out; instead, discharges are interpolated directly from the spillway rating curve. Continuity is not preserved. After the last observed pool elevation, both pool elevations and discharges are simulated by the Modified Puls routing method, again using the last observed pool elevation and adjusted discharge as a starting point for the new simulation process. This special case should be used whenever observed pool elevations are dependable. This option can be activated by specifying time series keywords OBSH, ADJH and ADJAQO and/or ADJQOM in the Utility ADJUST simultaneously.

User Guideline

The SPILLWAY scheme is coded originally with the intention that it is to be used with other schemes. If no other scheme is needed, it is recommended that FILLSPILL scheme be used instead.

For the gated spillway, the spillway rating curve should be generated by assuming all the gates are fully open. Since routing is required only if the pool elevation is at or above the pass inflow elevation, the portion of the rating curve below the pass inflow elevation won't be used during the routing computation.

The current code allows the spillway of a dam only as uncontrolled or as gated. If a dam contains both uncontrolled spillway as well as gated spillway, the simulation can be carried out through a composite spillway rating curve. If the uncontrolled spillway crest elevation is higher than the top of closed gates, the composite model should be assigned as a gated spillway. Otherwise, the composite model should be assigned as an uncontrolled spillway.