Changes made to reduce differences in Oroville operations between CalSim and CalLite

Problem: On AUG1987, CalSim makes significantly higher releases for export than in CalSim. This results in an SWP NOD-SOD storage difference that effects operations throughout the 1987-1992 drought.

Assessment: GOAL ORO\_RELEASES (file feather\_special\_CL.wresl), shown below, prevents releases in support of exports when the previous month’s end-of-month storage is below 1000 + DrainTar\_buffer. When BO is turned on, DrainTar\_buffer = 250. The JUL1987 storage in CalSim was just above 1250. The JUL1987 storage in CalLite was just below. So CalLite was restricted to making releases solely for IBU whereas CalSim was allowed to release for export even though July’s storage in Oroville differed by only a few thousand acre feet.

goal oro\_releases {

lhs C\_Orovl

case low\_storage {

condition S\_Orovl(-1) < 1000. + DrainTar\_buffer ! DrainTar\_buffer = 0 when int(OMRBOON)==1 as defined in delcar\_swp.wresl

rhs minflow\_C\_Therm

lhs>rhs penalty 3000.

lhs<rhs penalty 0 }

case norm\_storage {

condition always

rhs minflow\_C\_Therm

lhs>rhs penalty 0

lhs<rhs penalty 0 }

}

Solution: The difference caused by GOAL ORO\_RELEASES in AUG1997 is not real. It is simply the result of a roughly developed operational constraint applied at a monthly time-step. In realtime operations, releases would have been reduced to save Oroville storage in both cases. The solution is to base the constraint not only on the previous month’s storage, but also the current month’s inflow. I replaced GOAL ORO\_RELEASES with the following logic:

define C\_Orovl\_IBU {std kind 'flow-channel' units 'cfs'} !Weight with -3000 to replace commented out constraint oro\_releases.

define C\_Orovl\_EXP {std kind 'flow-channel' units 'cfs'}

goal split\_C\_Orovl {C\_Orovl = C\_Orovl\_IBU + C\_Orovl\_EXP}

define C\_Orovl\_EXP\_max\_ {value max(0., I\_Orovl + (S\_Orovl(-1) - 1000. - DrainTar\_buffer)\*taf\_cfs)}

goal lim\_C\_Orovl\_EXP {C\_Orovl\_EXP < C\_Orovl\_EXP\_max\_}

define C\_Orovl\_EXP\_max {alias C\_Orovl\_EXP\_max\_ kind 'upper-bound' units 'cfs'}

C\_Orovl is subdivided into two arcs – C\_Orovl\_IBU and C\_Orovl\_EXP. C\_Orovl\_IBU has no upper bound but is set to a -3000 weight in the objective function. Water will be released through this subarc only for IBU. C\_Orovl\_EXP has no negative weight but has an upper bound equal to storage in excess of 1250 TAF + current months inflow. C\_Orovl\_Exp releases can be used for either export or IBU.

This change should be made to both CalSim and CalLite. It should also be recommended as a permanent change to CalSim. This issue with Oroville frequently comes up in impacts analysis. When the impact is caused by GOAL ORO\_RELEASE, it is not likely a real impact. The code above will eliminate this problem.

There is a similar problem with GOAL RIVER\_VALVE\_FLOW in feather\_special\_CL.wresl as shown below.

goal river\_valve\_flow {

lhs C\_Orovl

case river\_valve\_only {

condition S\_Orovl(-1) < 850.

rhs 1500.

lhs>rhs penalty 1000000

lhs<rhs penalty 0 }

case units\_1\_3\_5\_rv {

condition S\_Orovl(-1) < 1250.

rhs 8700.

lhs>rhs penalty 1000000

lhs<rhs penalty 0 }

case full\_hyatt\_available {

condition always

rhs 17000.

lhs>rhs penalty 0

lhs<rhs penalty 0 }

}

I have replaced this constraint with the following logic:

define C\_Orovl\_valve {upper 1500 kind 'flow-channel' units 'cfs'}

define C\_Orovl\_PP135 {upper 7200 kind 'flow-channel' units 'cfs'}

define C\_Orovl\_Rem {std kind 'flow-channel' units 'cfs'}

goal split\_C\_Orovl2 {C\_Orovl = C\_Orovl\_valve + C\_Orovl\_PP135 + C\_Orovl\_Rem}

define C\_Orovl\_Rem\_max\_ {value max(0., I\_Orovl + (S\_Orovl(-1) - 1250.)\*taf\_cfs)}

define C\_Orovl\_PP135\_max\_ {value max(0., I\_Orovl + (S\_Orovl(-1) - 850.)\*taf\_cfs)}

goal lim\_C\_Orovl\_Rem {C\_Orovl\_Rem < C\_Orovl\_Rem\_max\_}

goal lim\_C\_Orovl\_PP135 {C\_Orovl\_PP135 < C\_Orovl\_PP135\_max\_}

define C\_Orovl\_Rem\_max {alias C\_Orovl\_Rem\_max\_ kind 'upper-bound' units 'cfs'}

define C\_Orovl\_PP135\_max {alias C\_Orovl\_PP135\_max\_ kind 'upper-bound' units 'cfs'}

The subarcs C\_Orovl\_valve, C\_Orovl\_PP135, and C\_Orovl\_Rem do not need to be weighted for this algorithm to work. However, to eliminate non-unique solutions for the subarcs, I’ve weighted C\_Orovl\_valve with 0.01 and C\_Orovl\_PP135 with 0.02.

The replacement of GOAL RIVER\_VALVE\_FLOW should be made in both CalLite and CalSim for the same reason GOAL ORO\_RELEASES should be replaced in both.