MODELING QUESTIONS ON FLAMING GORGE DEIS AND APPENDICES

Flaming Gorge DEIS

Q1) At page 23, the DEIS asserts that the Run of River Alternative failed to account for current depletions of 450,000 acre feet per year above Flaming Gorge Dam, according to Reclamation's Consumptive Uses and Losses Report, which is then not cited in the bibliography. The most current such report on Reclamation's website shows only 425,300 acre of current depletions as of the year 2000 above Flaming Gorge Dam, and perhaps a declining trend from 1996. What is the basis for the 450,000 acre feet figure and for the assumption that depletions will increase and not decline above Flaming Gorge Dam? How much of an increase beyond 450,000 acre feet was assumed and on what basis?

A1) The Flaming Gorge Model assumes current and future Consumptive Uses and Losses that are reported by the Upper Colorado River Commission (UCRC) in a memorandum dated December 23, 1999 entitled 'Estimates of Future Depletions in the Upper Division States'. The report indicates that current depletions in Wyoming are 489,000 acre-feet. Most, but not all of these depletions are located above Flaming Gorge Reservoir. This report indicates that Wyoming anticipates Consumptive Uses and Losses will increase over the next 50+ years by an additional 266,000 acre-feet and provides a schedule showing when these additional depletions will occur. The Flaming Gorge Model follows this schedule for future depletions.

Q2) Why is this document not referenced in the report? What about depletions on theYampa River? It is not apparent from the reading of the report.

A2) The depletion levels used in the CRSS model were adopted by the Flaming Gorge Model. Based on your comment, in retrospect, we believe that we should have described how and where the depletions came from in more detail. The Yampa River depletions came from the same document as all other depletions.

Q3) The DEIS indicates at page 134 and Figure 4-6 (page 135) that average monthly flows for the Action Alternative will be 1,100 cfs higher than the No Action Alternative in June and July, perhaps 200-300 cfs higher in August and September. What causes these substantially higher summer flow elevations, and what criteria were used to select them out the range for the baseflow recommendations for July, August, and September?

A3) During the months of June and July, Action Alternative Reach 2 flows would be about 1,100 cfs higher than the No Action alternative. This is largely the result of attempting to achieve the peak flow and duration recommendations described in the 2000 Flow Recommendations in wet, moderately wet, and some average years. The Reach 2 peak and duration flow thresholds described in the 2000 Flow Recommendations are higher than what are recommended by the 1992 Biological Opinion.

During the months of August and September (and July in drier years), baseflow levels are established under Action alternative by monitoring the unregulated inflow into Flaming Gorge Reservoir and establishing the current hydrologic classification (as defined in the 2000 Flow Recommendation). The baseflow range for Reach 2 is set based on this classification. Then the Reach 2 target flow is selected from within the baseflow range such that the elevation of Flaming Gorge can be effectively and safely managed. Each month, this process is repeated and adjustments are made as hydrologic conditions above Flaming Gorge Reservoir change. The No Action Alternative follows a similar decision making process however the baseflow recommendations are less specific but do recommend that Reach 2 baseflow levels during August and September be between 1100 and 1800 cfs. This specific recommendation is why the baseflow levels of the Action Alternative are actually higher during these months than the No Action Alternative.

Q4) Are the same depletions and operations listed in Table 4-31 (page 233) of the DEIS incorporated into the Flaming Gorge Model, the amendment to that model for Reach 3, or the Run of River Scenario? That table indicates current depletions above Flaming Gorge dam of only 372,000 acre feet, which is substantially lower than the assertion of 450,000 acre feet for the Run of River Alternative. This table indicates that the total current depletions for the Green River and tributaries is 1,583,960 acre feet, which is substantially higher than total depletion for the same area of 1,275,900 acre feet in the year 2000 per Reclamation's Consumptive Uses and Losses Report.

A4) As stated in the answer to question 1, the flow depletions used in the Flaming Gorge Model under the Action and No Action Alternative (and the Modified Run of River Alternative) all came from the same source. This source was the data provided by the Upper Colorado River Commission.

Q5) Table 4-31 footnotes the 1992 Flaming Gorge BO (footnote 5, page 233) as the basis for expecting 42,100 acre of new depletions above Flaming Gorge Dam in addition to 372,331 acre feet of current depletions, but there is no such level of new depletions listed in that BO or its Appendix A. What is the basis for the 42,100 acre foot figure?

A5)The hydrologic modelers are not the authors of Table 4-31.

Q6) What assumptions or adjustments to historic flow data were made to account for current or increasing depletions in the Flaming Gorge Model? At page 241, the DEIS states the Flaming Gorge Model assumes that water development would continue at the rate projected by the Upper Colorado River Basin Commission, without citation to any report. What rate is assumed and how does it compare with the most recent historic trends from Reclamation's Consumptive Uses and Losses Report?

A6) As stated in the answer to question 1, the rate of increase of depletions that was assumed in the Flaming Gorge Model was that provide by the Upper Colorado River Commission.

Q7) At page 241, the DEIS states that as water development increases over some unstated current level by some unstated amount, the releases from Flaming Gorge will have to increased to meet the flow recommendations, and it is not clear whether the releases to meet the recommendations for Reach 2 will also continue to meet them in Reach 3. Does this mean that the impacts of greater releases to meet the flow recommendations as water development increases in the future have yet to be disclosed and their impacts have yet to be addressed? If not, what increased depletions were modeled? If so, why can the Action Alternative be accepted without such disclosure and impact analysis, and when it may not meet the flow recommendations as water development increases?

A7) The Flaming Gorge Model does account for increasing depletions in the Yampa River and the Green River above Flaming Gorge Dam. But these are projected increases and not actual. The sentence on page 241…"It is uncertain what resource impacts would occur as a result of future water development in the Green River Basin above and below Flaming Gorge Reservoir." is indicating that impacts are uncertain because we do not know the specific increases in depletions that will actually occur in the future. We only have estimates and our confidence in these estimates is not completely certain.

Q8) Under the Action Alternative, baseflows in Reach 2 are allow to vary by 40% above a "targeted flow" from August to November, and by 25% from December to February, so long as the day to day change does not exceed 3%. What is the "targeted flow" level and how is it selected?

A8) This question is answered in the answer to question 2.

Q9) Are there any assumptions or built in foresight in the model that does not really exist in reality?

A9) The model does have a very good idea of what years will be the ideal years for achieving specific Flow Recommendation thresholds. The Flow Recommendations, for example, call for peak flows in Reach 2 that are 18,600 cfs or greater for 2 weeks or more in 40% of all years. The Flaming Gorge model knows whether or not the ensuing year will be a good candidate for achieving this threshold. Good candidate years have broad duration peak flows on the Yampa River such that bypass releases from Flaming Gorge can be minimized while still achieving the Flow Recommendation threshold. In reality, it is going to be difficult to identify ahead of time which years will be good candidate years for achieving this threshold and perhaps the Flaming Gorge model is too good

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Hydrologic Modeling Technical Appendix (App11-53)

Q1) Can you explain in more detail how the daily flow model for May/June/July (App-12) operates in conjunction with the output of the monthly model? It is not entirely clear what is meant by operating "…Flaming Gorge more realistically…" Exactly how does the daily model release "…the necessary volume for the remainder of the spring to match

the monthly model while minimizing additional bypass releases"? Does this step reflect how Flaming Gorge would be operated in real time?

A1) The monthly part of the Flaming Gorge Model manages releases to control the elevation of the reservoir from year to year while also releasing baseflow levels to achieve the 2000 Flow Recommendations (or 1992 Biological Opinion) during the months from August through February. During the months of March and April the monthly part of the model adjusts the elevation of Flaming Gorge as forecasted spring inflows are adjusted to provide a safe buffer for filling during the spring while maintaining reservoir storage. A mass balance approach was taken in this process and a spring release volume (May-July) was established in the monthly model. This spring release volume, along with hydrologic classification information was passed from the monthly part of the model to the daily part of the model.

The daily part of the model then takes this information and adjusts daily releases to match Yampa River flows to achieve specific peak flow and duration thresholds for the spring period under the current year hydrologic classification. The minimum peak flow and duration thresholds are described in the 2000 Flow Recommendations. Once these thresholds have been achieved, the daily model then distributes the remaining spring release volume such that power plant releases are maximized and bypass releases are minimized until the end of July.

As to the question regarding how Flaming Gorge Dam is operated in the model in comparison to how it would be operated in real time. We do recognize that Flaming Gorge would be operated differently in real time because more information is available to reservoir operators in real time as compared to the model. The model is a best attempt at simulating how Flaming Gorge would be operated in the future under the two alternatives. We do recognized that the Flaming Gorge Model (and reservoir modeling in general) is a generalized simulation of how the system will be operated in the future and does not provide an exact prescription for how the system would be operated in the future.

Q2) Can you explain how the 65 traces of inflow hydrology (App-14) were developed? The September 8, 2003 "Letter of Review" mentions the "indexed sequential method" (App-61) which we assume means reordering the historic record.

A2) Yes, there are 65 traces of historic hydrology that are routed through the Flaming Gorge Model with a set of initial conditions that does not change. We used historic hydrology beginning in 1921 and ending in 1985. Each trace was 39 years long so the first trace begins in 1921 and ends 39 years later. The second trace begins in 1922 and ends 39 years later. This process is continued until the 39th year is 1985. The very next trace adds 1921 hydrology after 1985 hydrology to continue the trace length of 39 years. This pattern is continued until all 65 traces are constructed.

Flaming Gorge Draft EIS Amendment to Hydrologic Modeling Report (App 55-67)

Q1) What assumptions/adjustments to Reach 3 historic flow data were made to account for current or increasing depletions in the amendment to the Hydrologic Modeling Report?

A1) These assumptions are pretty well described on page App-55 in the last paragraph. The modeling team had decided early on not to include data for Reach 3 because of the lack of information about how tributaries would be operated in the future. We amended the original report based on continued requests for hydrologic information in reach 3. We did our best to put the model output for Reach 2 together with historic depletions and flows for the tributaries in Reach 3. It was the best we could do given the lack of information of how downstream tributaries would be affected by future depletions on those systems.

Q2) The September 8, 2003 "Letter of Review" indicates at page App-64 that the Flaming Gorge model was modified to match later, more significant peaks on the Yampa, instead of any earlier peaks in late April or early May that sometimes exceeded 14,000 cfs. What criteria were applied in the modified model to pick out the later peak, and reduce power plant bypasses? The Letter Review on that same page also suggests that the unmodified model unnecessarily made large jet tube releases (which bypass the power plant) in 1962 as the second large peak on the Yampa was declining. What criteria were applied in the modified model to pick up that the second peak had peaked and to reduce jet tube releases? How does maximizing power plant releases at 4,600 cfs constantly from April through mid-July, as suggested on page App 64 better match Yampa peaks? Are power plant releases now maximized during these months under all run-off categories? Are such maximum power plant releases now extended through August 1 in moderately wet years and through August 15 in wet ones?

A2) There is no modified model. The "Letter of Review" is suggesting changes in operation that could reduce impacts to power generation that the model predicted would happen. There were no criteria applied to the modified model because there was no modified model. Releasing powerplant capacity releases from April through mid-July does not necessarily match Yampa peaks better but it is allowed under the 2000 Flow Recommendations as a means for moving water out of Flaming Gorge when necessary for hydrologic reasons. The Flaming Gorge Model attempts to reduce bypass releases as much as possible while still achieving the 2000 Flow Recommendations. There was an assumption in the daily part of the Flaming Gorge model that during the spring, the average daily flow of the Yampa River entering the Green River could be forecasted 24 hours in advance to +/-300 cfs of the actual flow. In order to be sure that thresholds would be achieved, target flows in Reach 2 were 300 cfs above the threshold. This assumption is yet to be tested in real time operation.

In the Flaming Gorge Model environment, August 1st is at point where the model changes it's operational mode from spring operations to baseflow operations. Therefore, when the model is releasing powerplant capacity in July, it does not extend these releases into

August as recommended in the 2000 Flow Recommendations. This was an inherent problem with the monthly model as it did not have the ability to divide a month into multiple operational regimes.

Q3) The "Letter Review" of the Flaming Gorge Model identified at page App 66 that the model locks in the baseflows for the following August through February time frame, and suggest that this constraint be relieved. Was this constraint relieved in subsequent modeling only by allowing the hydrologic classification or year type for the baseflow recommendation to be adjusted based on the prior month's flow categorization (wet, dry, etc.) whenever necessary to achieve the March 1 drawdown target? If not, in what other ways was this constraint relieved in subsequent modeling.

A3) We believe that the reviewers of the model thought that the +/-40% in the summer and +/-25% in the winter flexibility allowed in the 2000 Flow Recommendations would provide this flexibility. No adjustments to the reviewed model were ever conducted to test this theory.

Q4) The "Letter of Review" also states that the model locks in the amount of water that can be released in the May through July time frame (App 66-67), and recommends that the peak flow period be extended to August 1 in moderately wet years, and to August 15 in wet years? What criteria were applied in those months to relieve that constraint?

A4) The reviewers are pointing out that the model does not take into account all of the flexibility provided in the 2000 Flow Recommendations. The modelers recognized this observation but were constrained in the modeling environment. We believe that in real time operations, these issues would be resolved.

Q5) The "Letter of Review" suggests that another means of reducing the frequency of bypasses is to increase releases in April and May (App-63). Did Reclamation incorporate this suggestion and if so, did it accomplish a reduction in bypasses? Since it seems to assume an added level of foresight did it ever overshoot and lead to cases in which subsequent baseflows could not be met?

A5) The model has not been modified at this point based on the review recommendations.

Q6) Did Reclamation modify down-ramp rates as the "Letter of Review" suggests (App-65, 66)?

A6) The model has not been modified at this point based on the review recommendations.

Q7) Please specifically describe all the changes in the hydrologic modeling that were made as a result of the "Letter of Review."

A7) The model has not been modified at this point based on the review recommendations.

Modified Run of the River Modeling Report Technical Appendix (App 69-85)

Q1) As discussed at page App 80 for the Run of River Alternative, whenever reservoir elevations were below normal levels from August to February, releases from Flaming Gorge dam were set at a level that would achieve the baseflow recommendation at a lower level within the board range of the recommendation. Whenever reservoir elevations were above normal levels during the winter, releases were set to achieve the baseflow recommendation at a higher level within the specified range. Was any such rule applied subsequent to the Review Letter for the Action Alternative? If not, what criteria were applied in deciding what level (high, low, middle, etc.) within the wide ranges for the baseflow recommendations would be targeted for winter releases?

A1) The model has not been modified at this point based on the review recommendations. The criteria for deciding what flow within the recommended baseflow range in Reach 2 would be targeted is directly tied to the elevation of Flaming Gorge Reservoir.

Q2) It is not clear if the Modified Run of River Alternative accounts for current and increasing depletions or not. Page App 83 says not, but page App 84 says that the flow data for this alternative was adjusted to account for the same current and increasing depletions as the Flaming Gorge Model. Which is it?

A2) The depletion schedules in the Flaming Gorge Model under the Action, No Action and Modified Run of River Alternatives were identical.

Power System Analysis Technical Appendix (App 115-202)

As discussed previously, the Flaming Gorge Model was run under 65 different hydrologic scenarios referred to as traces. The Power System Analysis was run on 1 average trace selected from the set of 65. This trace, (Trace 36) was selected based on the average volume released from Flaming Gorge Dam of all traces for the first 20 years. Trace 36 had a 20 year volume that was very close to the average of all traces and consistent through the 20 year period. The hydrologic modelers provided the power modelers with daily releases from Flaming Gorge, daily flows of the Yampa River and monthly end of period reservoir elevations for Flaming Gorge. The time period that was provided was 25 years in length. There was a data set (trace 36) provided for both the Action and No Action alternative.

Q1) Table 3.2 (App-118) indicates the daily summer/winter "gage flows" presumably at Jensen range between about 900 – 3000 cfs for the Action Alternative, while they range from about 1100 – 1800 cfs in the summer and 1100 -2400 cfs in the winter for the No Action Alternative. How is this daily data at Jensen generated and is it already constrained by the flow recommendations. If it is not already constrained by the flow

recommendations, why are the ranges substantially different between the Action and No Action Alternative? If it is already constrained by the flow recommendations, why does Table 3.2 of the assumptions for the Action Alternative indicate that neither the 3% per day, nor the 40/25% limits are applied. If it is already constrained by the flow recommendations, why is the top end of the range for the Action Alternative so much higher than the top end of the range during the winter for the No Action Alternative, especially when the DEIS indicates at page 134 and Figure 4-6 that baseflows are generally lower under the Action Alternative than the No Action? How can the 3% per day limit be inapplicable if daily flows range between 900 – 3000 cfs for the Action Alternative?

A1) The hydropower analysis model utilized the hydrology data as the basis for hydrology flows. Within the limits of the hydrology data, releases through the hydropower plant were modeled such that the required conditions at Jensen would be met through feedback by the SSARR component while assuming that the plant operators would maximize the economic value of the hydropower generation. The ranges of flows for the Action and No Action Alternatives are based on the requirements set forth for each alternative and the given hydrology. Hydrology was modeled based on conditions set forth in the 2000 Flow Recommendations and the 1992 Biological Opinion.

The flow recommendations constrain the daily releases from the powerplant. For the No Action Alternative, the flows at Jensen were constrained by 12.5% of the daily average. For the Action Alternative, flows were limited to an intra-day change of 0.1 meters. Therefore, releases at the powerplant were modeled using the SSARR component so as to not violate these constraints.

The hydrology model did not adjust for the 40%/25% seasonal or the 3% daily flexibility. Table 3.2 indicates that because hydrology model did not adjust for these flexibilities, the hydropower model did not adjust for the flexibilities either. Not utilizing the flexibility on a daily basis doesn't affect changes in flows from one year to the next for the alternatives.

Q2) The hydrologic inflows for the hydropower analysis were adjusted for upstream regulation, projected consumptive uses, and losses at inflow points, App 128. How do these assumptions for depletions compare with those made for the Run of River Alternative, and all for other hydrologic modeling for the DEIS, and what is the basis for these depletions assumptions if they are different?

A2) Hydropower analysis used the output from the hydrologists' models so these assumptions for depletions are already built into the modeling by the hydrologists.

Q3) Although both daily and hourly future flow data were projected for inflows to Flaming Gorge reservoir and the Yampa River (App 128), the schematic (Figure 4.1, App 135) indicates that the output of the modeling of reservoir releases is monthly flow data, from which a single, representative hydrologic trace was selected. How is that monthly data then combined with the daily data from the Yampa to analyze compliance with the

daily or hourly limits in the flow recommendations at Jensen? What controls the level of monthly releases from the reservoir and the variation of releases within any month, or day for this modeling? In essence, we would like to understand the Green River simulations and the SSARR Simulation components of the modeling process in Figure 4.1.

A3) The hydropower model does not project inflows to Flaming Gorge Reservoir, only projected releases, as indicated on App128. These releases were coordinated with the Yampa flows. The hydropower modeling uses a representative hydrologic trace of monthly flow data from which daily flow data is extracted so as to achieve flows that meet the conditions required at Jensen. Daily flow data was modeled from montly data; not combined. Monthly flows are provided by the Green River hydrology model as described by the hydrology section of this document. The model was designed to achieve the constraints as required at the powerplant and at Jensen based on integration with the SSARR Simulation component. The hydropower model was designed to economically optimize the daily releases for power generation for each alternative. The SSARR component provided feedback to the model, indicating whether the flows met the constraints at Jensen. If there were violations at the gage, then the model was re-run until the generation was optimized and no violations occurred.

Q4) Figures 8-3 through 8-8 (App-187-192) depict the hourly results over a week of the modeling package as constrained by "upper and lower gage limits" for average, relatively dry, and relatively wet "hydropower" conditions that are significantly different between the Action and No Action alternatives, yet there is no mention of these gage limits in Tables 3.1 and 3.2 purporting to show the differences in assumption between the two Alternatives, or any other discussion of the basis for these limits. Tables 3.1 and 3.2 even indicate that the 3% per day and 40/25% limits on base flow variations are not applied for the Action Alternative. What then are the "gage limits" shown in Figures 8-3 through 8-8 and how do they relate to the flow recommendations? Do they represent 12.5%/day limit for the No Action Alternative and the .1 m/day limit for the Action Alternative?

A4) The 3% per day and 40/25% flexibilities are not modeled. The gage limits that are shown in these figures are based on the flow recommendations of 12.5 % limit for the No Action Alternative and the .1 m limit for the Action Alternative. The figures are examples designed to show that the flows at Jensen would meet the required limits even with large fluctuations in releases at the powerplant. Flows smooth over the distance between the powerplant and the gage. The hydropower model is designed to generate power at peak times while meeting the powerplant constraints (such as minimum releases) but also meeting the flow constraints at Jensen.

Q5) The description of Green River simulations (App-193) appears to use a different drawdown target and date (elevation 6,026, April 1) than that which is presented elsewhere (see App-12, elevation 6,027, April 30). Do we misunderstand this?

A5) It appears that the text on App 193 is incorrect and does not correspond with the material on page App12. Therefore, this sentence needs to be corrected to match App12.

Fortunately, this does not affect the analysis as drawdown targets are not an input into the hydropower model. The hydropower model only uses hydrology data from the Green River model as provided by the hydrologists, which is not affected by this typing error.

See Table 2-3 on page 29 of the DEIS. The definitive description of the drawdown targets for May 1st. There is also a drawdown target used for March 1st in the model. This target is 6027 feet above sea level and during the base flow period (from the end of the spring peak release to the end of February) the model attempts to operate within the ranges specified in the Flow Recommendations (or Biological Opinion) while managing the reservoir elevation to this drawdown target.