Peer Review of Solar at the Central Arizona Project (CAP) White Paper with Comment Disposition

Date: September 27, 2016

Originating Office: Research and Development Office, Bureau of Reclamation, Mail Code 08-10000, PO Box 25007, Denver CO 80225

Reclamation Roles:

Director or Delegated Manager: Levi Brekke, Chief, Research and Development Office, Bureau of Reclamation

Peer Review Lead: Erin Foraker, Renewable Energy Research Coordinator, Bureau of Reclamation

Subject and Purpose: Reclamation's Research and Development Office funded a project in conjunction with its Phoenix Area Office to write a white paper that examines and identifies the issues on placing solar over the Central Arizona Project canal systems. This study was to inform Reclamation of the potential impacts to its operation and maintenance (O&M) of the canal system, cost impacts on O&M, benefits, and other areas of concern or issues of interest in this area. The Phoenix Area Office planning and engineering groups jointly developed the white paper based on Reclamation's authorities to operate and maintain this canal system and features. This was not intended to be a full appraisal-level investigation nor a feasibility level study.

The purpose of this Peer Review Plan is to facilitate stakeholder and expert review of the white paper to enhance its content.

Impact of Dissemination: The white paper is not considered influential or highly influential scientific information as defined by Office of Management and Budget Final Information Quality Bulletin for Peer Review (70 FR 2664-2677) and the Reclamation Manual Policy CMP P14 Peer Review of Scientific Information and Assessments. The nexus of this determination is that this document may provide a clearer understanding of the concerns associated with this topic, however there is no known decision or policy that will be affected by its dissemination. This peer review is considered discretionary based upon Reclamation Manual Policy CMP P14.

Peer Review Scope: This discretionary peer review is focused on the white paper's summary and analysis of available information supported by O&M experience, canal design, and potential research needs. Peer reviewers are asked to provide responses relative to the questions below:

Question 1. Based on your experience, does the white paper accurately reflect canal owner or operator experience for placing a structure over the canal or along its right of way? Does the white paper accurately reflect impacts to O&M including inspections, canal access, and structural integrity?

Question 2. What (if any) other information might have been considered to support the analysis summarized in the white paper?

Question 3. Are there other important research needs associated with solar over canals

or along its rights of way that were not identified in this report?

Manner of Review, Selection of Reviewers: The review will take place on Reclamation's Peer Review Agenda website. Public, expert, and stakeholder review will occur concurrently through targeted invitations from Reclamation. Canal owners and operators, engineers, and other relevant experts dedicated to the engineering or operations of canals and associated structures will be asked to nominate potential peer reviewers. The expert peer reviewers will have least 10 years of experience with canals, including such fields as canal design, canal construction, and canal operation. Public comments will not be provided to the expert peer reviewers. Reviewers will be given attribution for their comments and not remain anonymous.

Number of Peer Reviewers: It is anticipated that no more than 10 peer reviewers will be utilized.

Timing of review: July 12, 2016 to August 5, 2016

Delivery of findings: Following the review period, the Peer Review Lead will deliver the findings as an appendix to the white paper. At a minimum, this will include a description of the peer review process, subject being reviewed, and reviewer comments. Reclamation will publish this completed peer review summary document on the peer review website (http://www.usbr.gov/main/qoi/peeragenda.html).

Applicability of Federal Advisory Committee Act (FACA): This peer review is not subject to the Federal Advisory Committee Act (FACA) because reviewers are being asked to provide individual reviews on the subject matter. Reclamation is not seeking consensus advice from the reviewers as a group.

Agency contact: Erin K. Foraker, Reclamation's Infrastructure and Renewable Energy Research Coordinator (eforaker@usbr.gov).

Comment Disposition:

Comment ID	Reviewer, Organization	Comments	Resolution
1	Central Arizona Water Conservation District	Inspection of canals and structures along the canal are predominately visual and require clear lines of sight into the top areas above the canal prism along the 2:1 slope. The proposed installation of the canal mount system would hinder effective and efficient access for these types of visual inspections.	Impacts to O&M revised to include "Installation of solar over the canal would impact visual inspections,"
2	Central Arizona Water Conservation District	Lining repairs as required due to settlement and/or erosion within the 2:1 slope which caps the top of the lining would be highly impacted by blocking access to mobile equipment to facilitate effective repairs.	Impacts to O&M revised to include "The truss foundations placed on the canal banks would block access to large mobile equipment for canal repairs, road maintenance, and weed spraying."
3	Central Arizona Water Conservation District	Roadway maintenance maybe hindered by the foundations of any support structure. This is a linear operation performed by road graders. The main purpose of road way repairs is to provide proper sloping away from the canal prism. This will likely be impacted by the necessary support structures. Roadway width next to the canal is utilized for the movement of at times large mobile equipment. Again the concern would be access down the length of the roadway.	Impacts to O&M revised to include "The truss foundations placed on the canal banks would block access to large mobile equipment for canal repairs, road maintenance, and weed spraying."
4	Central Arizona Water Conservation District	Terrestrial weeds are controlled by the use of weed spraying trucks that articulate on to the 2:1 slope face. The proposed structural elements would likely turn this into a much more manual operation impacting the effectiveness of our weed spraying program.	Impacts to O&M revised to include "The truss foundations placed on the canal banks would block access to large mobile equipment for canal repairs, road maintenance, and weed spraying."
5	Central Arizona Water Conservation District	A lot of sediment is windblown into the canal. The panels would be elevated so it probably wouldn't decrease the amount by much. The maintenance to keep the panels clean of the windblown sediment and maintain efficiency would be significant, especially for the panels in the middle of the canal.	Panel cleaning is an optional maintenance practice. Dirty panels reduce efficiency by 1-3%.
6	Central Arizona Water Conservation District	As a public entity CAP has a responsibility to keep water rates as low as possible and it is cheaper to buy power.	Revised Executive Summary to include "As a public entity, CAWCD has the responsibility to the public to keep water rates as low as possible."
7	Central Arizona Water Conservation District	Another fact to support the point that PV is not sufficient to offset CAP's power is that PV energy does not provide the reactive power required to start motors.	Revised CAP Power Demands to include "Solar over canal should not be considered to be a replacement for current power sources."
8	Central Arizona Water Conservation District	When discussing safety, potentially describe the safety considerations associated with generating and transporting electricity so close to a large body of water.	Revised Additional Considerations to include "Other issues to consider are: dangers of transporting power near large quantities of water, transmission of power from the panels, O&M maintenance costs and responsibilities, longer truss spans, more materials, higher construction costs, canal embankment availability, canal embankment penetration, panel and truss removal and replacement for O&M on the canal lining or embankments, increased loadings on the canal embankments, and environmental impacts."
9	Central Arizona Water Conservation District	A potential consideration is the need for increased security/fencing/barriers along the canal to prevent trespassing.	Revised Additional Considerations to include "Trespassing would need to be addressed by increased security, fencing and barriers."

10	Central Arizona Water Conservation District	If solar panels were placed over/near the canal, they would need to be electrically connected to the transmission system. This would require installation of new transmission lines as well new (or modification to existing) substations. Equipment required may include circuit breakers, relaying stations, transmission towers, etc. This would require agreements with WAPA/APS/SRP and would increase the cost of PV substantially.	Revised Additional Considerations to include "Other issues to consider are: dangers of transporting power near large quantities of water, transmission of power from the panels, O&M maintenance costs and responsibilities, longer truss spans, more materials, higher construction costs, canal embankment availability, canal embankment penetration, panel and truss removal and replacement for O&M on the canal lining or embankments, increased loadings on the canal embankments, and environmental impacts."
11	Central Arizona Water Conservation District	There may be a need to have access to the solar panels that are over the canal for panel maintenance.	Additional Considerations includes "No consideration is given for buried utilities, operations and maintenance (O&M) access for the panels or the canal,"
12	Central Arizona Water Conservation District	The alignment of the canal and the surrounding property isn't consistent so placing the panels in the most efficient direction or angle may not be possible.	Additional Considerations includes "The structural panel supports may not work in many locations along the CAP without additional engineering considerations due to the bearing and sinuosity of the canal."
13	Central Arizona Water Conservation District	We may or may not have the right of way to place the panels off the canal so the property may have to be purchased.	Revised Design Assumptions to include "• Right-of-way is owned by Reclamation and available for use."
14	Central Arizona Water Conservation District	There would be additional costs (to CAP or the responsible entity) to maintain the PV system because maintenance staff would need to be hired and trained to properly maintain the PV installations.	Revised Additional Considerations to include Other issues to consider are: dangers of transporting power near large quantities of water, transmission of power from the panels, O&M maintenance costs and responsibilities, longer truss spans, more materials, higher construction costs, canal embankment availability, canal embankment penetration, panel and truss removal and replacement for O&M on the canal lining or embankments, increased loadings on the canal embankments, and environmental impacts."
15	Central Arizona Water Conservation District	Power transmission from the PV field would have to be accounted for and would add substantial cost to this project.	Revised Additional Considerations to include "Other issues to consider are: dangers of transporting power near large quantities of water, transmission of power from the panels, O&M maintenance costs and responsibilities, longer truss spans, more materials, higher construction costs, canal embankment availability, canal embankment penetration, panel and truss removal and replacement for O&M on the canal lining or embankments, increased loadings on the canal embankments, and environmental impacts."
16	Central Arizona Water Conservation District	It would be helpful to provide more detail on the energy calculations which conclude that one mile of solar panels over the canal could provide 65 megawatt hours of electricity annually during on-peak hours.	Revised CAP Power Demands to include calculations in a footnote "One mile of solar panels over the canal provides approximately 9,000 megawatt hours during on-peak hours annually"
17	Central Arizona Water Conservation District	The impact of floating thin film photovoltaics should be investigated/discussed to determine effects on aqueduct capacity.	Revised Thin film photovoltaics to include "If this were to be pursued, the corrosive water conditions and changes in canal capacity would require additional study"

18	Central Arizona Water Conservation District	The shade and associated reduction of light and temperature may affect the wildlife living in the canal. Certain species of wildlife serve a beneficial purpose. For example, certain fish species are added to the canal each year to control growth of aquatic vegetation.	Revised Additional Considerations to include "Other issues to consider are: dangers of transporting power near large quantities of water, transmission of power from the panels, O&M maintenance costs and responsibilities, longer truss spans, more materials, higher construction costs, canal embankment availability, canal embankment penetration, panel and truss removal and replacement for O&M on the canal lining or embankments, increased loadings on the canal embankments, and environmental impacts."
19	Central Arizona Water Conservation District	Further study may be needed to determine if these structures would adversely affect the O&M roads in terms of width or buried utilities especially in areas where the canal is in fill.	Revised Additional Considerations to include "No consideration is given for buried utilities, operations and maintenance (O&M) access for the panels or the canal,"
20	Central Arizona Water Conservation District	The structures to support the panels over the canal may cost much more than the panels themselves.	Design Assumption includes "The design assumptions in this white paper are not all inclusive and a more robust engineering design study is required."
21	Central Arizona Water Conservation District	Would CAWCD be responsible for providing the maintenance of the solar panels? If so, the study should address the projected annual cost of this maintenance.	Revised Additional Considerations to include "Other issues to consider are: dangers of transporting power near large quantities of water, transmission of power from the panels, O&M maintenance costs and responsibilities, longer truss spans, more materials, higher construction costs, canal embankment availability, canal embankment penetration, panel and truss removal and replacement for O&M on the canal lining or embankments, increased loadings on the canal embankments, and environmental impacts."
22	National Renewable Energy Laboratory	Table 4 is misleading because it does not give credit to energy generated by PV. would be more meaningful to compare the ADDED cost (~$1M) of installing over the CAP to a ground mount PV	Revised Table 4 to include "Cost Comparison for Installation Costs to Cover Canal with Solar versus Water Evaporation Savings to generate 1 MW over 975 feet of canal"
23	National Renewable Energy Laboratory	There could be a minor benefit to PV energy production because the PV may operate a little cooler because of the cooling provided by canal water.	Revised Photovoltaics to include "The canal may have a cooling effect on the panels which potentially could result in minor increases in efficiency and power production."
24	National Renewable Energy Laboratory	If ground mounted PV could be installed along the south edge of the canal and be tall enough to provide shading of the canal the PV may reduce evaporation at a much lower cost?	Revised Conclusions to include "Additional research that was identified include: improved structural cost estimates, improved O&M cost estimates, improved impacts to O&M, impacts to the canal and canal lining, evaporation studies including evaporation with shading, installations along the south edge of the canal for evaporation reduction,"