UNITED STATES DEPARTMENT OF INTERIOR
U.S. Geological Survey
Water Resources Division
California District
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To: Furnished record cooperators
Re: Powerplant Flow Record Reviews
(Originally sent to one cooperator -November 19, 2009)

I am writing to you as I understand there has been some confusion among hydrographers as to what we, the USGS, expect as documentation for powerplant flow records that are submitted to us for annual review. Specifically I am told they are asking how to document the flow thru the turbines if there is no place to make standard flow measurements upstream or downstream, or if there is no place to attach a clamp-on type acoustic flow meter (AVM) device to verify recorded flow records.

In brief, the USGS is looking for documentation that can enable us to do a proper review of the records and to obtain documentation that we can archive for how a furnished table of daily mean values of discharge, in cubic feet per second, was produced.

The options to produce powerplant discharge record include:
1) AVM monitored flows
2) Electrical Generation/flow ratings (watthours to cfs)
3) Pitot tube recording instruments

Options for verifying these flows include:
1) Independent flow measurement(s) by standard streamflow measurement techniques.
2) Backup AVM's or portable clamp-on type AVM's
3) Dye-dilution tests
4) Electrical generation/flow rating table(s), plots and equations, including head correction if applicable, and history of rating(s) during current water year.
5) Instrument calibration information, programming input information.

As we further develop our procedures for verifying powerplant flows we look to get as much information as is currently available for a site and to work with furnished record providers toward attaining more documentation as needed.

For example, if a site has not had any independent flow measurements made to verify the recorded flow record, or if there are no locations available to do this, we would want to receive at a minimum some information on how the daily mean flow values were produced. For a site that simply coverts electrical generation data to cfs this could be in the form of rating information. For an AVM type site we would want to see calibration and maintenance information for the instrument and transducers.

This verification information may come from your organization or from outside contractors. In some cases AVM's and/or transducers are returned to manufacturers for calibration checks. Copies of these reports, along with information on when instruments were serviced, can serve as documentation.

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Typically for a powerplant record the materials that should be provided for review include:

- Daily values table for the water year
- Hydrograph of daily discharge values
- Log of visits to site: readings, equipment/program changes etc.
- Copies of instrument servicing, calibration, program changes
- List of discharge measurements (including portable AVM checks if any)
- Copies of discharge measurements (if any)
- Primary computation sheets (hourly computational values)
- Copy of any graphic record used for computation
- New rating tables and new rating curves (such as power to flow conversions, pitot tube stage /discharge etc.)
- Station Description including a section on Quality Assurance (see examples below). A description of the rating could be included in the Discharge measurements section or the Quality Assurance section. Items that should be included in describing the rating include: date the rating was developed, the technique that was used to develop it, the persons, agencies, or contractors who developed it, the operational range and sensitivity of the rating over that range, description of planned activities to check the rating or maintain its applicability.
- Station analysis (explaining how record was computed and why ratings or computational methods were applied as they were or changed for the current water year)

Some further information from USGS Quality Assurance Plan:

Ratings Based on Powerplant Records

Discharge ratings developed for well-maintained turbines and penstocks are usually very stable and accurate. However, worn or damaged meters, orifices, valves, and piping or obstructed passages may result in significant rating changes. The planned technique for ensuring the accuracy of turbine and penstocks ratings, and how often the technique is to be used, should be described in the "Quality Assurance" section of the station description. Where possible, such ratings should be checked periodically by independent data such as measurements made using current-meters or AVMs (Acoustic Velocity Meters).

Generally, UVM ratings are stable and accurate, but periodically they should be verified by an independent means such as using temporary clamp-on UVM's, current meter measurements, or against independently developed turbine ratings. UVM instrumentation should be monitored for signal strength and inspected for system wear or damage. Plans for quality assuring UVM data should be described in the "Quality Assurance" section of the station description.

Other devices or structures in use for measurement of discharge also are subject to change, so any rating developed must be checked periodically just as in the case of a stage-discharge rating.

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Turbine wear can change head-flow relationships over time. Intake pipes may become coated with mineral deposits, increasing resistance to flow. AVM transducers may fail, resulting in a biased estimate of the velocity profile, and thus, the average velocity. Any of these changes can result in biased discharge estimates.

Planned activities to check ratings might include type and number of check measurements anticipated each year, or a plan for explaining the circumstances under which a hydraulic structure or its components will be re-rated, cleaned, repaired, or replaced. If engineered structures, AVMs, power-plant ratings, or other non-standard streamgaging techniques are used, the station description must include a brief discussion of the applicability of the non-standard technique(s) to the computation of streamflow, how the rating for that system was established, its functional limitations, and how the system is maintained.

The following are sample write-ups for the Quality assurance section of the Station description for powerplant systems that can be used by your hydrographers to define possible work scenarios and to further explain what the USGS is looking for:

- Example 1 (Power Plants): "This power plant rating was confirmed by the salt-dilution method (Gibson methods, pitot tube methods, etc.) in 1940 by the AAA Turbine Company under contract with the BOR. There is no access for current meter measurements due to backwater from the downstream lake. (Other limitations might apply such as irregular channel bottoms that degrade measurement condition such that measurements are considered poor or unusable by the USGS.) The intake pipes are coated with calcium deposits that have greatly increased flow resistance and may have caused the rating to be in error at low heads. A UVM system has been ordered and will be installed in 2002 to replace the old rating for this intake."

- Example 2 (AVM): "This AVM was installed in 1985 by the AAA Streamgagers Company. The system consists of 16 transducers in a 60 inch steel pipe 50 feet downstream of the nearest pipe elbow. The transducer readings are temperature-compensated by a temperature probe installed in the turbine forebay near the intakes. The temperature probes are calibrated twice each year with a scientific grade thermometer. The cross-sectional area of the pipe is clean and no changes in area were observed during inspections when the plant was dewatered in 1998. Transducer signal strength is routinely monitored to detect failed transducers. Two transducers failed this year. These failures were reported to the vender who furnished a revised area-weighted coefficient that was applied to compute the mean velocity from the remaining transducers. The unit is expected to be replaced in 2001".

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- Example 3 (AVM): "This AVM was installed in 1990 by Power Omega Corporation. The system consists of 4 transducers in a 36-inch pipe 25 feet downstream of the nearest elbow. The AVM rating is checked twice each year utilizing a strap-on AVM. When the errors exceed 5 percent the unit is serviced or replaced."

- Example 4 (AVM): "This AVM was installed in 1990 by Tiny Drop Power Company. The system consists of 8 transducers in a 36-inch pipe 25 feet downstream of the nearest elbow. The AVM results match power plant rated flows for heads from 15 (minimum operations pool) to 50 feet (spillway crest) as determined by examination of current records on the 15th of each month in 2001. Flows exceeding the AVM rating are determined by indirect methods at a constricted bridge opening 0.5 miles downstream."

We at the USGS appreciate the continuing work of hydrographers and managers in producing quality streamflow and reservoir records and the strong working relationship that we have enjoyed in the past. If you or any of your personnel have any questions regarding this letter or submission of powerplant records please feel free to contact any of our regional area Field Office Chiefs or myself at (916) 278-3168 or dohall@usgs.gov.

Sincerely,

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Cc
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