F/NWR5

MEMORANDUM FOR: Hydro Program Files

FROM: Steve Rainey

Subject: WES Trip Report - Chief Joseph Deflectors

I traveled to WES from 10/12-15/99 for the purpose of interfacing with Corps of Engineers representatives from Seattle District and WES on design parameters needed to proceed with deflector design development at Chief Joseph. Representatives from other federal and state agencies were also present (see attachment #1).

Spillway-Model Description/Status
This spillway is much steeper and higher than those in the lower river, and will present design challenges. There are nineteen spillway bays, each with 36' tainter gates. Modeling will be an important part of defining deflector elevation, radius of curvature, and length. The sectional model is 1:40, and has been watered up for only a short period. The initial model deflector configuration to be installed is from the 1979 deflector model study (see attachment #2), and has a 12.5' length, 10' radius, and an elevation of approximately 175. Performance curve testing cannot proceed until identification/confirmation of design tailwater and spill per bay design quantities - which is one of the primary purposes of this gathering. Multiple deflector configurations will be evaluated to identify the optimum alternative.

The 1:80 general model bathymetry has still not been refined at this point, but will be soon. It was watered up on 10/13 for the first time to allow subjective observation by the northwest contingent. It will be primarily used once the optimum deflector configuration has been selected. Numerous issues will require attention with the general model, including erosion investigations and powerhouse-deflector flow mixing.

Schedule - Attachment #3 shows the tentative schedule. The critical path calls for completion of a feasibility study by early January. This is very much a fast-track process, and it

is expected a year may be lost if the study completion date is not met. This may put a squeeze on interaction with the agencies - always the first thing jeopardized when the schedule is tight. The next step is for the district to interface with Corps Headquarters, gain endorsement and funding, then start plans and specs by September 2000. Construction award is scheduled for January 2001 (which we suggested the Seattle District reconsider in favor of a late-summer start). It is anticipated two winter work windows will be required, and awarding the contract in January will potentially minimize progress within the 2001-02 work window. Funding will come through Construction General, rather than CRFM, channels. Completion is scheduled for March 2003.

Design Operating Conditions
It was apparent Marian had spent a lot of time preparing for this discussion (attachment #4). The Chief Jo peak instantaneous 1997 flow was 297 kcfs (a 20-50 year event), and the 7Q10 discharge was 241 kcfs. Although there were many hourly readings over 241 kcfs in 1997, those over the 7Q10 discharge were considered over the design operating range. (If the deflectors are designed for tailwater elevations in this higher flow, more infrequent range, performance at more frequent spill and tailwater range will be compromised.) We agreed that the higher design spill discharge (including Chief Jo and Grand Coulee as a composite unit and negating spill at Grand Coulee) led to the higher design spill flow. Below 200 kcfs project discharge, Grand Coulee apparently doesn't spill. Therefore, the design Chief Jo total project discharge should range from 200-241 kcfs. Since 18 of 19 spill bays are to be equipped with deflectors, and a total spill of 20 kcfs (1 kcfs per bay) with no deflector gave TDG readings not exceeding 120%, it is expected that spill of up to 2 kcfs per bay with a deflector (36 kcfs spill) will limit plunge to the extent that 120% TDG can be attained. Further, during 1997 the highest spill level between 200 and 241 kcfs project flow at Chief Jo was approximately 172 kcfs. **Therefore, the target spill range for this juncture is 36 to 172 kcfs, at project discharges of 200 to 241 kcfs.**

Since tailwater elevations in the design spill range are important in setting deflector elevations, Marian provided results of investigations on Chief Jo tailwater ranges. From 1996-99, forebay elevations were lowered by Douglas PUD during late May through late June. This directly influences tailwater at Chief Jo. This is partially related to backwater effects on power generation at Chief Jo, but may also be

related to other factors (such as irrigation levee or pump station overtopping). Ideally, Douglas PUD could control the Wells Dam forebay to aid in minimizing TW fluctuation during the range of conditions described in the previous paragraph, thereby augmenting deflector performance. Marian will check this in greater detail with the PUD and district personnel who may be knowledgable about these issues.

Future Potential Operating Changes
As previously referenced, future operation of Chief Joseph and Grand Coulee will continue to be based on composite operations. While exact operations continue to be refined in the context of a broader number of mid-Columbia hydro projects, it is currently anticipated that an effort to negate the need for spill at Grand Coulee will result in no gas abatement improvements at GC (since the 7Q10 spill would approach zero), while an incremental spill increase (as described above) would be the basis for deflector design at Chief Jo.

Discussions are ongoing concerning the need for varied discharges from Grand Coulee to satisfy fish needs (such as stranding of juveniles in the Hanford Reach). This deflector design does not assume operating changes will occur. If they do, it may have some degree of impact on optimum deflector operation during spill. These future operational uncertainties are beyond the scope of existing work.

Near-Field Test Results
Mike Schneider described results of near-field (and far-fieled) testing at Chief Jo. Highlights include:

- Stilling basin endsill TDG readings of up to 175% were logged, as high as seen on the river.
- Readings at higher discharges dropped from 175% to 135% by at the FMS.
- Mike believes operation of only (approximately) half of the spill bays during testing may have resulted in elevated FMS readings relative to what entire spillway readings may have been.
- Powerhouse and spill flows from Chief Jo were believed to be 80% mixed at Brewster Flats.
- High discharges from Okanogan and Methow Rivers aided in diluting TDG readings.
- Wells forebay readings were well mixed, and TDG readings from testing were never close to test ceilings that would have limited the 1999 spring test.

Model Observations
We observed in the 1:40 sectional model a deflector with a 10' radius, 12.5' length, and approximate el 775.0. This is the initial shape that will be tested, but a performance curve has not been developed. Nappe depth was definitely shallower and higher velocity at 5 kcfs per bay. This may lead to shorter length deflector being acceptable. It appeared to me that skim flow was achieved at tailwater elevations between 781 and 785...at 780, there appeared to be some plunge. There is still speculation whether skim and other hydraulic classification bands in the performance curve will be wider or narrower.

We asked that multiple performance curves be prepared for representative lengths and curvatures of deflector toe-curves, so that we could observe trends for ourselves. WES agreed to comply, and to keep us abreast with their progress. It was agreed photos of multiple sectional test conditions would be provided for our review.

System Modeling
Mike Schneider then reviewed the system model he has been working on for a few months. This initiative was new to me, and is apparently funded by BPA, rather than CRFM. The scope is from Grand Coulee to Dworshak to Bonneville. The objective of this model is to predict and forecast FMS readings, with a goal of identifying where to shift spill for water quality reasons, and (concurrently) to gage impacts of fish passage optimization spill operations. **In effect, this is an effort to model system operations in the manner supported by the SCT during 1997 (when initial discussions on gas abatement at Chief Jo and Grand Coulee were being initiated.** The primary focus is the Chief Jo-Grand Coulee composite operation at this point. TDG monitoring systems have a ways to go to optimize the broader potential of this model, especially at PUD locations. However, this also holds true at the eight CRFM projects. Near-field testing (having shed light on dynamics in some reaches) will also be used to temper input. The modeling output will only be as good as input.

Mike’s model will use tailwater and forebay TDG input, then (potentially) assign TDG reservoir loss in TDG mass to come up with inputs.

Next Steps
The next step for us will be a video conference to gage modeling progress. Marian will set this up and be at WES when

the agencies are to be invited to tune in. I advised that while this would not be a satisfactory approach for one of the downriver projects, where fish are present - it may suffice for Chief Jo. We will definitely be limited in our ability to interface and change the agenda to allow observation of different operations, and handouts need to be provided in advance, but it is worth a try. If insufficient observation of modeling effects of both sectional and general models are possible, it may be appropriate to send an agency representative with satisfactory deflector experience down to WES as a point for the other agencies and tribes. A video-conference date will be set up by Marian for (probably) early December.

Cc Schneider, Mark
Valentine, Seattle District