APPENDIX D

Alternative MS1-2-5

ENGINEERING ALTERNATIVE

ALTERNATIVE NO: MS1-2-5 **PAGE NO: 1 OF 9**

TITLE: USE SYSTEM AS DESIGN, EMERGENCY CLOSURE. REPAIR RATHER THAN REPLACE BULCKHEAD, ADD SEPARATEWATERING ACCESS AND UPGRADE CRANE TO MEET LOAD REQUIREMENTS.

ORIGINAL DESIGN:

The original design calls for demolishing the existing concrete filled stoplog and replacing it with a new steel, multi section bulkhead. It also calls for rehabilitating the existing bridge crane and installing an entirely new trolley and hoist system keeping the rating at the existing 75 tons. It also calls for the rehabilitation of the existing wheeled gate. No change is made to the existing method of watering up the irrigation tunnel which is to pull the wheeled gate against a fully unbalanced load to a height of approximately 6 inches and letting pool water fill through this small opening.

ALTERNATIVE DESIGN:

The design alternative recommended by the VE team keeps the original concrete filled bulkhead, rehabilitating it by cleaning and painting and furnishing new seals. To handle the weight of this bulkhead, the design alternative calls for the contractor to evaluate the bridge crane and design and implement the changes necessary to increase the rating to 100 tons. This alternative also rehabilitates the wheeled gate the same as in the original design. The final aspect of this alternative is to have the contractor design and install an alternative, safer method of watering up the irrigation tunnel.

ADVANTAGES:

1. Utilizes existing concrete filled stoplog instead of providing a new, multi section bulkhead.
2. Eliminates the need to demolish and dispose of the existing concrete filled stoplog.
3. Provides a safer method of watering up the irrigation tunnel. The current method puts the highest loading on the bridge crane and is difficult to control.
4. Eliminates the need to handle and store multiple bulkhead sections.
5. Maintains the original design intent of using the concrete filled stoplog and wheeled gate as a backup emergency closure device in case one of the irrigation conduits cannot be closed.

DISADVANTAGES:

1. The bridge crane trolley and hoist must be designed to have a 100 ton rating rather than the existing 75 ton rating.
2. The bridge of the crane must be analyzed and perhaps beefed up to be rerated at 100 tons.

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JUSTIFICATION:

The original design report states that the design was intended to be closed under partial flow conditions. The following is taken from that report:

> Mr. Growdon of the Board of Consultants recommended the following changes in design of the intake structure:
>
> (a) Provide a means for closure of the upstream portal with the reservoir at the maximum water surface El 1,045 meters, and with a flow of 100 cubic meters per second (3 500 cfs) through the tunnel.
>
> (b) Permit the removal of trashracks with the reservoir at maximum elevation.
>
> These recommendations were eventually adopted.

This design report discussed four alternatives for the intake closure gates with alternative four being the one selected as follows:

> In the fourth scheme, the portal was divided into two (2) openings by a concrete pier. One opening was 3.05 meters (10-ft) wide by 9.15 meters (30-ft) high, and the other opening 1.98 meters (6.5-ft) wide by 6.10 meters (20-ft) high, the height of the latter opening being reduced by a sill. The larger area could be closed under a small unbalanced head by a reinforced concrete bulkhead. The smaller opening would then be closed under unbalanced head conditions by a fixed-wheel gate. This scheme proved to be most economical and was ultimately adopted.

This shows the intent of being able to use the system for closure in the event that the flow through the irrigation tunnel could not be stopped using either the hollow jet valves or the rotovalves. This is not a true “emergency” closure since the system is not

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capable of stopping the full flow of the tunnel. It is more of a redundancy to allow closure in case one of the conduits cannot be shut off by either the rotovalve or the hollow jet valve. This appears to be the present situation as described below in a 2005 report from the Combined Forces Command.

"Because of the lack of maintenance, reservoir intake gates are inoperative and one of the outlet valves is currently jammed at 35% open and cannot be open further or closed. Maintenance personnel are unable gain access to the valves because they are unable to close the gates at the intake tower. The gates have not been operated in 50-years and require total rehabilitation. Weathering has dry rotted gate seals and damaged electrical motors. Looting of mechanical and power supply parts have occurred."

"The jammed valve is allowing approximately 10 m^3/s of water to leave the reservoir unregulated. In an arid region like southwestern Afghanistan every drop of water must be conserved. More importantly is the danger that the unmaintained outlet valves come become jammed completely open or shut with no access to repair. Should additional gates become jammed that could jeopardize 31% of the nation's irrigated land and the primary power supply to Kandahar."

The operation and maintenance manual for the irrigation tunnel describes normal operation for closure of the intake gates as follows:

IIA-2. Irrigation Tunnel

a. Unwatering - The general rules applying to the intake tunnel have already been stated. The procedure for unwatering the tunnel at Kajakai Dam is as follows:

1. Start the emergency generating unit and shut down the service hydroelectric unit.
2. Close the hollow-jet valves.
3. Lower the bulkhead to closed position.
4. Lower the wheel gate to closed position.
5. Open the hollow-jet valves.

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This clearly shows the intent during normal operations to have the water flow in the tunnel stopped by use of the hollow-jet valves (or the rotovalves). However, further information regarding the operation of the concrete stoplog (bulkhead) indicates that it can be operated as long as no more than one of the hollow-jet valves is being operated as follows:

IIA-4. Bulkhead

a. Operation and Maintenance - Before raising or lowering the bulkhead the tunnel should be full of water, but not flowing, and the wheel gate should be open to insure that the water pressure against the bulkhead is balanced. The bulkhead cannot be lowered if more than one conduit is flowing.

This correlates with the description of design intent provided in the design report. The drawing for the intake gate hoist further confirms this design intent and operation on the hoist loading curves shown below. The curve titled “Lowering Gate” shows a peak loading on the hoist of approximately 222 kips from the venturi effect under the gate as the opening approaches 2 ½ feet. The table entitled “Handling Stoplog” shown below gives the weight of the concrete filled stoplog as 195,000 lbs when it is in air and 122,000 lbs when it is submerged. The 195,000 lbs loading is a normal operating load for the hoist and it exceeds the hoist rating of 75 tons. The VE team feels that if the hoist trolley can be replaced with one capable of lifting 100 tons, the normal operation will be within the rating of the crane. If emergency closure would be needed, the crane rating would be exceeded slightly upon lowering the wheeled gate, but we feel that this is an acceptable risk.

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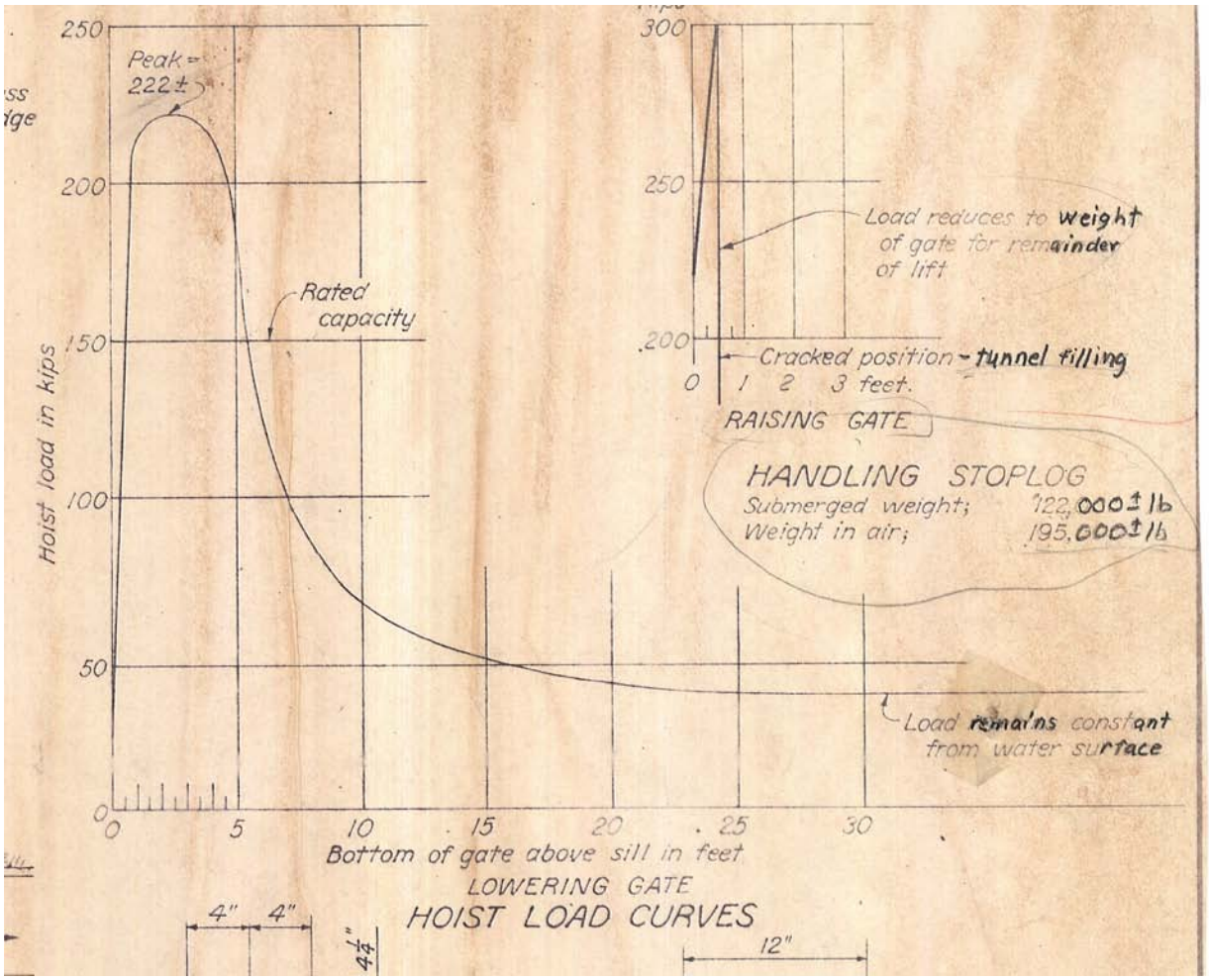

The other curve shown above titled “Raising Gate” shows a peak loading of 300 kips is required to lift the wheeled gate off the sill to allow the irrigation tunnel to be watered up. This is a normal operation as described below in excerpts from the O&M Manual. This loading, although very short term is a normal operation that doubles the load on the existing hoist and would exceed the rating of the new hoist by 50%. The VE team feels strongly that this is an unacceptable risk and that a safer, alternative method of filling the irrigation tunnel should be designed and installed by the contractor. This can be as simple as installing a remotely operated valve in the skin plate of the wheeled gate. A sketch of such a design is included in the drawings section.

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b. Filling - To fill the tunnel and conduits, the procedure is as follows:

1. Close the hollow-jet valves, conduit drain valves and the valve to the service hydroelectric unit.

2. "Crack" the wheel gate by raising it 15 cm. Leave the gate cracked until the escape of air from the tunnel vents in the intake structure has stopped, indicating that the tunnel has filled. This should take from three to four hours, or longer when reservoir water level is low.

3. Raise the wheel gate to "open" position. Raise the bulkhead to "open" position.

To fill the tunnel with water, the discharge and upstream conduit valves should first be closed. The intake gate should then be cracked by raising it about 6 inches. The gate must not be opened wider, even momentarily, until the tunnel has been filled.