PRINCIPLES OF SHARING COSTS ASSOCIATED WITH OPERATION AND MAINTENANCE OF THE WATER FACILITIES OF INTERSTATE JOINT USE

Prepared by:
Adrian O. Hutchens

August 1999

Prepared for:

Central Asia Mission
U. S. Agency for International Development

Environmental Policy and Institutional Strengthening Indefinite Quantity Contract (EPIQ)
Partners: International Resources Group, Winrock International, and Harvard Institute for International Development

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1.0 Project Authority And Purpose

As part of the USAID sponsored EPIC program, assistance is being provided to the Executive Committee of the Interstate Council for the Republic of Kazakstan, the Kyrgyz Republic, the Republic of Tajikistan and the Republic of Uzbekistan (ICKKTU) to develop regional principles on financing of operation and maintenance (O&M) of international (transboundary) water facilities of the region.

The lack of funds for O&M of transboundary water facilities in the region is a principle underlying cause of severe water mismanagement. With the transition to market-based institutions, pricing schemes and other new approaches are being developed which may be used to generate revenues for routine O&M investments. The ability to recover such costs is also a precondition to most external financing of water related investments.

The facilities considered here include transboundary water facilities of regional river basins, including interstate rivers, canals, and collectors. These facilities, which form the backbone of water management systems in Central Asia, have deteriorated rapidly since the collapse of the Soviet Union and they are in severe need of basic O&M repairs. The various water management authorities dealing with the transboundary facilities of Central Asia are well aware of the need for more integrated management and greater financing for O&M in order to resolve these problems.

An agreement was entered into in March of 1998 by the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan.(March 1998 Interstate Agreement)(8) The Republic of Tadjikistan became a party to the agreement in June of 1999. That agreement did not specify how O&M funding would be generated.

One of the economic issues that may constitute potential constraints to the full implementation of the Interstate Agreement identified in that paper is determining what, if any, cost sharing arrangements are appropriate for operation and maintenance of common hydro-technical structures.(3)

The purpose of this paper is to present principles and an example of a cost allocation method that could be used as an illustration to facilitate discussion on the regional principles on sharing O&M costs of the transboundary water facilities. The example used here is drawn from the Syr Darya basin since that is the system for which the authors had data and information.

2.0 Transboundary System

The transboundary system consists of storage reservoirs and conveyances that serve more than one of the member republics. The storage reservoirs are Toktogul, Andijan, Kayrakum, Charvak, and Chardara. The associated main transboundary canals and collectors that serve more than one of the member republics make up the transboundary conveyances.

Figure 1 presents a schematic diagram of the basin showing the five major reservoirs, active storage capacity, installed hydro-power capacity, and service areas. Even in this simplified diagram, the interdependence of the transbasin facilities is apparent. It is quite clear that the transboundary storage and conveyance system is the underlying framework on which a massive basin-wide water supply and delivery system rests, and upon which the economy of each Republic is heavily dependent.

3.0 Management Of The Transboundary System

Management of the Naryn-Syr Darya transboundary system is conducted through the actions of the following organizations:

- Interstate Coordination Water Commission (ICWC)
- River Basin Management Authority (BVO Syr Darya)
- United Controlling Center of Energy Systems of Central Asia (UDC Energia)
- National water and energy agencies of each of the basin republics.

ICWC is a commission authorized by the Central Asian water ministries to provide the institutional foundation for management of the transboundary system, formulates common water management policy, approves diversion limits and reservoir operational schedules, and coordinates major water activities. (4)

BVO Syr Darya is the executive interdepartmental body of ICWC for the Syr Darya Basin. It provides observance of the schedule of flows and water consumption with due regard for water flows to the Aral Sea. The BVO develops operational schedules for storage reservoirs, sets limits for each diversion works, estimates water shares for each state, and submits operational schedules of storage reservoirs to ICWC. (4)

UDC Energia schedules the day-to-day releases from Toktogul reservoir based on energy demand after BVO Syr Darya has determined the volumes (monthly and 10 day) to be released. (5)

The BVO and UDC-Energia are currently the executive bodies with responsibilities for release schedules and energy transfers.(2)

The National water and energy agencies of the Syr Darya Basin countries are the operational entities responsible for maintaining the hydro-technical facilities of the basin.

4.0 Current O&M Funding

O&M for the transboundary facilities is funded through two sources. Those facilities that produce hydro-electric energy obtain O&M funding through the rate structure applied to energy sales. The rest of the transboundary system obtains O&M funding individually from the state budget of the republic in which the facility is located. Neither source provides sufficient funding to meet the needs of ensuring long term sustainability of efficient system operation. The cost allocation effort described in this paper deals only with cost sharing of O&M for transboundary water supply facilities. It does not deal with hydro-electric facilities. Therefore, in order to ensure that the allocation of costs for the water supply facilities is equitable to all parties, it is necessary to exclude the separable and joint hydro-electric costs.

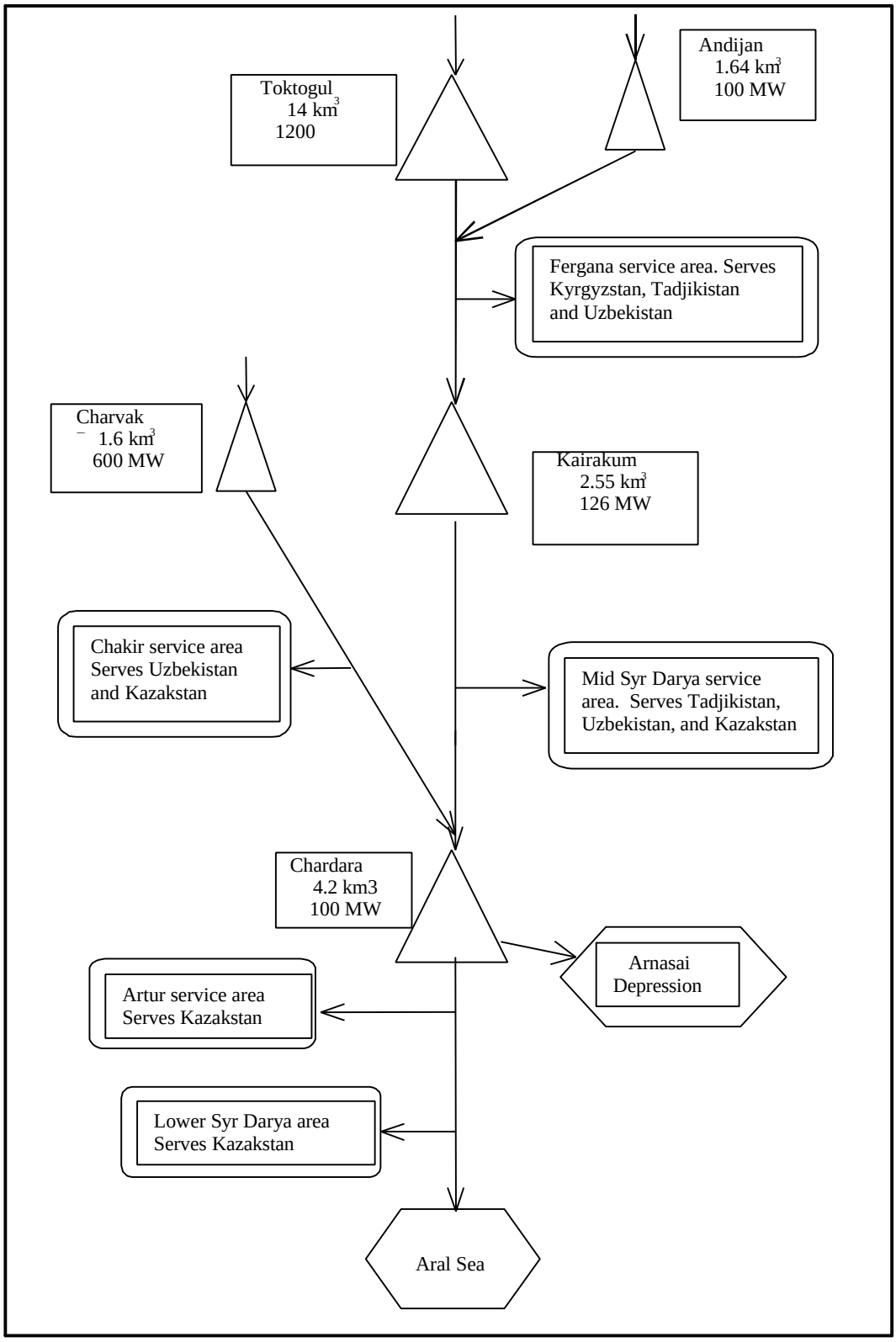

Figure 1. Schematic of Syr Darya Basin.

Water pricing is seen as a supplementary source for funding O&M within each Republic. However, it is not a direct source of funding for the Republic on which the transboundary facility lies to recover O&M costs of that facility, since water pricing is a matter of national policy for each independent Republic. Adequate funding of O&M for transboundary facilities should be a Republic to Republic obligation independent of national pricing policies or the lack thereof.

Sharing the costs between republics based on rational cost allocation principles is a way of providing adequate levels of O&M. Article VII of the March 1998 Interstate Agreement states that, "The Parties agree that the operation, maintenance, and reconstruction of water and energy facilities shall be covered in accordance with the ownership of the property referred to in the balance sheet and the legal right of ownership." (2)

That article is generally interpreted as requiring the republic in which the facility lies to finance and conduct O&M of those facilities. It does not provide for the Republic that owns the facilities to recover O&M costs associated with providing water services to other Republics.

A precise estimate of the needed level of funding for O&M of the five transboundary reservoirs has not been made, but a cursory estimate is that from 2 to 3 times the present level is needed to ensure long term sustainablility of services. That implies that the current level of O&M for these facilities is approximately 40% of what is needed. Funding for O&M of the conveyance components of the transboundary facilities has become progressively more deficient over time. In 1997, the level of funding was only 37% of the needed level to sustain long-term system operational efficiency. That deficiency in funding has led to a deterioration of water management ability. It has been stated that, "The process of decline in the management is seen everywhere, and in some places management has been totally lost, which is very dangerous for the future of irrigated agriculture and water management facilities." (6, p. 2)

There is one thing that is clear, the present method of funding O&M costs of the transboundary system is not meeting the financial need. There is a definite need to identify alternative methods of sharing the financial burden in order to ensure adequate operation and maintenance of the facilities.

5.0 Criteria For Successful Cost-Sharing

In this situation, each republic that owns, operates, and maintains a transboundary facility, functions as a water supplier to themselves and to the other republics. The republics receiving that water are intermediate water users served by the transboundary system. They pass the water on to the final water users within each Republic. Sharing the O&M costs among the republics on a Republic to Republic basis is the most likely way of providing adequate funding.[1]

The primary criteria for a successful cost-sharing agreement between parties is acceptability by each party. In order to gain acceptability, each party must feel that the cost-sharing agreement is equitable. In order for the cost-sharing agreement to be perceived as being equitable, it must be transparent and understandable. That is, all principles and assumptions underlying the allocation and all steps in the calculation process must be clear and open to review by all parties.

Also, in order for water users to view any cost sharing agreement as being acceptable, they must feel that they are receiving reliable service for the funding that they contribute and that those payments are clearly understood to represent only the cost of services rendered. That is true whether the water user is a republic serving as an intermediate supplier or a direct water user such as an irrigator.

It is incumbent upon water supply managers to deliver water supplies, however limited, on a predictable and efficient basis. To do that, the water supply and delivery system must be in good operational condition. To ensure that the system is in good operational condition, there must be an adequate level of funding for O&M of the system that is allocated equitably among the water recipients.

[1] The degree to which O&M costs provided by the republics through their respective state budgets are recovered from water users is an internal matter within each republic that must be handled according to their respective water pricing policies.

6.0 Alternative Cost Allocation Methods Considered

The physical O&M of the transboundary facilities and the financial support of the O&M is the responsibility of the respective republics in which those facilities lie. (2, Article VII) However, since the transboundary system provides beneficial services to all of the basin republics, it would be more equitable if all benefiting republics share in the cost of O&M for those facilities and, in addition, it would more likely provide adequate funding, which is not being provided under the present financing methods. There are methods of cost allocation that can yield equitable results to all parties.

Three commonly used cost allocation methods are described here. Those are the separable cost-remaining benefits method (SCRB), the alternative justifiable expenditure method (AJE), and the use-of-facilities (UoF) method. Which method is used depends on the data that are available since the methods have different data requirements and it also depends on the underlying assumptions on which the allocation is to be based.

If the beneficiaries of the water system are all in one country and the water rights within that country are dependent on the water being put to beneficial use, the allocation of costs is usually based on the benefits received. In those situations, the use of the SCRB method or a variant of that method such as the AJE method are often used. If the beneficiaries are in more than one sovereign political entity, the allocation of costs of transboundary facilities is usually based on the amount of water that is received by each political entity. In that situation, the UoF method is most applicable.

The SCRB method requires specific derivation of benefits for each function served. The AJE method is actually the SCRB method adjusted to account for the lack of ability to derive imputed separable costs. The UoF method rests on the assumption that the degree of use of the facilities provides a reasonable proxy for benefits received.

Before discussing the methods, perhaps it would be useful to briefly define some terms used in the allocation methods.

- Benefits: Quantifiable gains resulting from the use of the facilities.
- Investment costs: Cost of all inputs required to construct the facilities.
- O&M costs: Costs required to operate and maintain the facilities.
- Separable costs: The combination of specific single-purpose costs and imputed single-purpose costs.
- Specific single-purpose costs: The cost of a part of the facility that functions exclusively for a single service function, but is not an integral part of the common works of the facility, for example, a power plant that is specifically separable from the dam. Removal of that part of the facility would not impact the cost of or service from any other component of the facility.
- Imputed single-purpose costs: The cost of a feature that is an integral part of the common works. A hydropower penstock that is built into the dam is an example. It is integrated into the dam, but it serves only the power purpose.

Such a cost can be separated from the dam, but in so doing, the cost of the dam itself would be changed. Such costs can be separated by comparing the cost of the dam without penstocks with the cost of the dam with penstocks. The difference in cost of the dam with penstocks and the dam without penstocks is the imputed separable cost that is assignable to the hydroenergy function. This requires a major effort in engineering design which is normally conducted during the planning stage prior to construction.

- Joint costs: The joint cost is the cost remaining after subtracting all separable costs from the total cost of the facility.
- Single-purpose alternative costs: The cost of the most likely alternative way of providing the same level of benefits of a single-purpose facility if the proposed (existing in this case) multipurpose facility were not built. An example would be the cost of the most likely way the same level of power benefits could be provided if the multipurpose facility being evaluated were not built. Or, the most likely way that the same water supply could be provided for irrigation if the structure being evaluated had not been built. Clearly, the consideration of single-purpose alternates is best dealt with in an *a priori* planning setting where irreversible commitments have not already been made.

6.1 Separable Cost-Remaining Benefit Method of Cost Allocation

The SCRB method is the most likely to yield equitable results when used in a planning setting. However, it is the most demanding of data. Usually the heavy data demands are only met in an *a priori* planning setting, that is, during the planning stage before the facility has been built. Data requirements include total project costs, benefits provided by the project for each user group, single-purpose alternative costs, specific costs, imputed separable costs, and joint costs. The basic steps involved in applying the SCRB method are:

1. Derive the benefits for each purpose served by the facility (hydropower, irrigation, flood control, etc.).
2. Derive the alternative costs of single-purpose projects for each purpose served that would yield the same level of benefits as the multi-purpose facility would provide for each of those purposes.
3. Identify the specific costs.
4. Derive the imputed separable costs for each purpose, which is the difference in project cost with and without each purpose.
5. Deduct the separable costs for each purpose from either the benefits or the alternative single-purpose costs associated with each purpose, whichever is less, to determine the remaining justifiable expenditure for each purpose.
6. Deduct the sum of all of the separable costs from the cost of the total facility to determine remaining joint costs.
7. Allocate the remaining joint costs to the purposes served in proportion to the remaining justifiable expenditures derived in step 5.
8. Sum the separable costs and allocated remaining joint costs to get the total allocated costs for each purpose served.

6.2 Alternative Justifiable Expenditure Method of Cost Allocation

The AJE method, sometimes referred to as the adjusted separable cost-remaining benefit method, was developed for use in situations where derivation of the imputed separable costs is not feasible, but all other data requirements of the SCRB method are met. The steps are the same as the SCRB method without considering imputed separable costs.

1. Derive the benefits for each purpose served by the facility (hydropower, irrigation, flood control, etc.).
2. Derive the alternative costs of single-purpose projects for each purpose served that would yield the same level of benefits as the multi-purpose facility would provide for each of those purposes.
3. Identify the specific costs.
4. Deduct the specific costs for each purpose from either the benefits or the alternative single-purpose costs, whichever is less, to determine the remaining justifiable expenditure for each purpose.
5. Deduct the separable costs (sum of all specific and imputed separable costs) from the cost of the total facility to determine remaining joint costs.
6. Allocate the remaining joint costs to the purposes served in proportion to the remaining justifiable expenditures derived in step 5.
7. Sum the specific costs and allocated remaining joint costs to get the total allocated costs for each purpose served.

6.3 Use of Facilities Method of Cost Allocation

The UoF method of cost allocation is based on the degree to which each party uses the facilities. Physical relationships such as quantities of water delivered, flow levels, and allocated storage space are some common measurements used as proxies for the level of use of facilities. This method is often used in the following situations:

- Where project benefits for each function served are not available and the derivation of such benefits are beyond the scope of the allocation study.
- Where the cost allocation is intended to reflect the stability inherent in water rights decrees rather than how the water is used.

The steps employed are:

1. Derive the level of use of joint project facilities for each purpose. Measures such as flow rates, water deliveries, reservoir capacity assigned to each purpose, energy generating capacity, and energy generated are often used to represent the level of use by each purpose.
2. Identify the separable costs for each purpose served.
3. Deduct all separable costs from the total project cost to determine the remaining joint cost.
4. Allocate remaining joint costs to each purpose served in proportion to the use-of-facilities factors developed in step 1.
5. Sum the separable and allocated remaining joint costs to get the total allocated costs for each purpose served.

7.0 Model For Allocating O&M Costs

The UoF cost allocation method was selected as the most appropriate because:

- The facilities in question are already in place.
- Water is delivered to the Republics on the basis of fixed historical shares of the water supply rather than benefits realized within each Republic.

This model is limited to allocating O&M costs when there are no outstanding capital recovery obligations for any of the transboundary facilities; therefore there are no capital costs associated with those facilities to allocate. Of course, future capital costs for new facilities or capital improvements to existing facilities can be allocated when those facilities are being considered for implementation by including annualized costs of the capital improvement.

The water supplies received by each Republic are treated in total amounts received by each Republic rather than separating them according to the respective functions served. For example, within Kazakstan water is distributed for irrigation, industrial use, municipal use, fisheries, and water transportation. How, when, or if the water supply received is allocated to these functions is an internal matter for each Republic to address according to their own policies.

7.1 Submodel for Deriving Allocatable Costs

The O&M costs to be allocated can be identified by subtracting out the separable costs for all non-water supply functions from the total O&M costs for the facilities. The remaining costs are the costs that must be allocated between the Republics. That process is represented by the following formula:

$$C_A = C_T - (S_P + S_E) \qquad \text{Equation (1)}$$

where C_A = O&M water supply costs to be allocated
C_T = total O&M costs for the facility in question
S_P = O&M costs of the separable hydro-energy facilities
S_E = O&M costs of any other non-water supply function such as recreation facilities, social development, etc.

Equation 1 ensures that only O&M costs directly related to supplying water to the Republics will be allocated.

7.2 SUBMODEL FOR ALLOCATING COSTS TO THE REPUBLICS

After deducting the separable non-water supply costs, the remaining costs, which should be only those O&M costs related to providing water supply, are then allocated to the Republics in proportion to the water received. The resulting allocation to each Republic is depicted by equation 2.

$$C_{Ri} = C_A (W_{Di} / W_T) \qquad \text{Equation (2)}$$

where C_{Ri} = O&M water supply cost allocated to Republic i,
C_A = total water supply O&M costs to be allocated,
W_{Di} = water supply received by Republic i, and
W_T = total water supply delivered to the Republics.

Subject to $\sum C_{Ri} = C_A$ Equation (3)

and $\sum (W_{Di} / W_T) = 100\%$ Equation (4)

Equation 2 ensures that those costs will be allocated in proportion to the amount of water received. Equations 3 and 4 ensure that all of the O&M water supply costs of transboundary facilities will be allocated to the receiving Republics.

It should be noted that, in the example considered here, water is released to (1) the Aral Sea and (2) to non-productive side locations such as the Arnasai depression. If delivery of water to the Aral Sea is assumed to be a joint responsibility of all of the republics, and water spilled to Arnasai is assumed to be the collective result of management, or mismanagement of the system, which is also the joint responsibility of all of the republics, it seems equitable that the costs of managing those waters should be allocated among the Republics.

The costs of managing those waters are real and should be addressed equitably. Those releases are not included as water deliveries (W_{Di}) by this model, but they are included in the total water supply provided by the transboundary facilities and the cost of managing those waters are in the total water supply O&M cost (C_A). Therefore, since the sum of the proportions ($\sum W_{Di} / W_T$) of water supply delivered to each Republic adds up to 100%, the costs associated with managing the water released to Arnasai and the Aral Sea are automatically allocated to the Republics in proportion to the water deliveries to each Republic.

8.0 Example Cost Allocations

Two example cost allocation variants were developed based on two different perspectives on the use of Toktogul Reservoir. On the one hand, under normal water years it is said to be possible that all water supply needs could be met without Toktogul Reservoir. (7) On the other hand, Toktogul Reservoir is seen as allowing irrigation of new lands with the irrigation mode being its top priority. (10) Therefore, Variant 1 is based on the assumption that normal water year conditions prevail and all water supply needs could be met without Toktogul Reservoir. Variant 2 is based on the assumption that the operation of Toktogul Reservoir contributes to meeting water supply needs.

8.1 Elements Common to both Variants

There are elements that are common to both variants including assumptions and calculations.

Both variants are based on the following assumptions:

- The transboundary water supply facilities are operated as an integrated system.
- The water produced is a non-differentiable product of that system.
- Costs will be allocated in proportion to the water delivered to each republic.
- Transboundary conveyances and associated headworks only provide water supply, they do not serve energy purposes. Therefore, O&M costs for these facilities are separable to serving the water supply purpose.
- Since virtually all releases from reservoirs, other than Toktogul, are used jointly for both energy and water supply, it is impossible to allocate joint reservoir costs on the basis of water releases. Therefore, as an alternative, it was assumed that joint reservoir costs are distributed in proportion to the ratio of the separable power costs to the total facility cost.[2]

Sufficient data were not available for completing a cost allocation that represents actual conditions; therefore, to illustrate how the model is applied, two hypothetical examples were fabricated. The results do not necessarily represent the outcomes that would be produced if actual costs and delivery data were used. This merely illustrates the process of conducting a cost allocation using this model.

Even though the UoF cost allocation method is quite straightforward, derivation of the costs to be allocated is not. Care must be taken to exclude those

[2] It could have been just as logically assumed that the ratio of separable costs to joint reservoir costs be used, which would have allocated a larger share of joint costs to energy. It also could have been assumed that, since all releases are jointly used for energy and water supply, reservoir costs should be divided equally between energy and water supply.

costs not related to water supply. That can require a greater effort than performing the cost allocation.

8.1.1 Derivation of Transboundary Costs to be Allocated

The transboundary facilities consist of the five storage reservoirs and the transboundary conveyances. Complete cost data were not available for either of these. Therefore, for the sake of constructing the example, hypothetical cost data were fabricated.

8.1.1.1 Example Costs of Storage Reservoirs and Energy Facilities

Some cost data were available for Toktogul reservoir, but not for the other four storage reservoirs of the system. Therefore, the cost relationships for Toktogul were used to differentiate energy costs from reservoir costs. These relationships were then used to estimate the energy and reservoir costs for Andijan, Kayrakum, Charvak, and Chardara reservoirs for this example. The data for Toktogul reservoir are presented in Table 1.

Table 1: Annual O&M Costs of Toktogul

	Operation ($1000)	Maintenance ($1000)	Total O&M ($1000)
Toktogul Dam & Reservoir	2720	1030	3750
Separable hydro-power	620	450	1070
Remaining joint costs	2100	580	2680

Source: (7) Table 5-3

Given that the separable hydro-energy costs are specific to the energy generating facilities and the remaining joint costs relate to the reservoir, we get the following relationships for Toktogul:

Separable energy cost per MW = ($1.07 x 10^6)/(1200MW) = $890/MW

Reservoir costs per km^3 = ($2.68 x 10^6)/(14km^3) = $191,000/$km^3$

Assuming those relationships hold for the other transboundary reservoirs, the following imputed costs result using the derived cost per MW and the installed generating capacities to estimate separable energy costs, and the derived cost per km^3 of active storage capacities were used to estimate reservoir costs:[3]

Toktogul:	Separable energy facilities		$ 1,070,000
	Reservoir costs		2,680,000
	Total O&M		$ 3,750,000
Andijan:	Separable energy facilities	$890/MW x 100MW =	$ 89,000
	Reservoir costs	$191,000 /$km^3$ x 1.64 km^3 =	313,000
	Total O&M		$ 402,000

[3] Active storage capacity was used because it was thought that it related more to O&M costs than total storage capacity. It was reasoned that the difference, dead storage, is more related to capital investment costs.

Kayrakum:	Separable energy facilities	$890/MW x 126MW =	$112,000
	Reservoir costs	$191,000/km^3 x 2.55 km^3 =	487,000
	Total O&M		$599,000
Charvak:	Separable energy facilities	$890/MW x 600MW =	$534,000
	Reservoir costs	$191,000/km^3 x 1.6 km^3 =	306,000
	Total O&M		$840,000
Chardara:	Separable energy facilities	$890/MW x 100MW =	$ 89,000
	Reservoir costs	$191,000/km^3 x 4.2 km^3 =	802,000
	Total O&M		$891,000

8.1.1.2 Example Costs for Transboundary Conveyances

No cost data were available for the transboundary conveyances and associated diversion control gates so, considering the extensive network involved, it was assumed that the O&M cost for transboundary conveyances are 2.5 times the O&M cost for storage reservoirs. This results in a cost figure of $4740 thousand ($1896 thousand x 2.5). Admittedly, there is no justification for this other than it provides a cost figure to be allocated in the example.

8.2 VARIANT 1: Toktogul Serving Energy Only

The joint costs allocated to energy for Andijan were derived as follows:

Separable cost for energy	=	$ 89 thousand
Joint cost	=	313 thousand
Total	=	$ 402 thousand

The separable energy cost is 22% of the total (89/402); therefore, 22% of the joint cost was allocated to energy in addition to the separable cost. The remaining joint reservoir cost was allocated to water supply.

Table 2: Annual Transboundary O&M Storage Costs to be Allocated

		($ thousands)	Reservoir costs allocated to energy ($ thousands)
Toktogul:	Energy facilities	1070	
	Reservoir	2680	All allocated to energy
	Subtotal	3750	
Andijan:	Energy facilities	89	
	Reservoir	313	22% allocated to energy = 69
	Subtotal	402	
Kayrakum:	Energy facilities	112	
	Reservoir	487	19% allocated to energy = 93
	Subtotal	599	

Charvak:	Energy facilities	534	
	Reservoir	306	64% allocated to energy = 196
	Subtotal	840	
Chardara:	Energy facilities	89	
	Reservoir	802	10% allocated to energy = 80
	Subtotal	891	

8.2.1 Allocation of O&M Costs to Energy and Water Supply

The resulting allocation to purposes served, energy and water supply is presented in Table 3. It was assumed that the conveyances serve only water supply; therefore, all of the $4740 thousand estimated O&M costs for conveyances were allocated to water supply.

Table 3: Allocation of Annual O&M Costs to Energy and Water Supply

Description	Separable Costs ($ 1000)	Joint Costs ($ 1000)	Total Costs ($ 1000)
Allocation to energy			
Toktogul	$ 3750	$ 0.0	$ 3750
Andijan	89	69	158
Kayrakum	112	93	205
Charvak	534	196	730
Chardara	89	80	169
Conveyances	0.0	0.0	0.0
Subtotal	$ 4574	$ 438	$ 5012
Allocation to water supply			
Toktogul	$ 0.0	$ 0.0	$ 0.0
Andijan	0.0	244[a]	244
Kayrakum	0.0	394	394
Charvak	0.0	110	110
Chardara	0.0	722	722
Conveyances	4740	0.0	4740
Subtotal	$ 4740	$ 1470	$ 6210
Total cost allocated to purposes	$ 9314	$ 1908	$ 11222

a. Reservoir costs minus joint energy cost ($313 - $69). See pages 10 & 11 and Table 2 for the derivations of the numbers in this column.

8.2.2 Allocation of Water Supply Costs to the Republics

The allocation of water supply O&M costs to the republics was based on the historical water shares received by each republic in percentage of total supply (8, p. 112, Table 10.2) The allocation to the republics of the $6210 thousand of allocated water supply O&M costs is presented in Table 4.

For energy, the costs were assumed to be accurately reflected in the rates charged for energy. The allocation of the $5012 thousand in energy costs to the Republics are presumed to be accounted for in the rate structure for energy delivered to each Republic. Therefore, they are no longer a component of this allocation process.

Table 4: Allocation of Annual Water Supply O&M Costs to the Republics

Republics	Historical shares of Water Deliveries (%)	Allocated Costs ($ thousands)
Kyrgyz Republic	5.0	$ 311
Tadjikistan	7.5	466
Uzbekistan	57.3	3558
Kazakhstan	30.2	1875
Total	100.0	$ 6210

8.3 VARIANT 2: Toktogul Serving Energy and Water Supply

Variant 2 is based on the assumption that meeting the water supply requirements is dependent on the operation of Toktogul Reservoir. (10) The joint costs allocated to energy for Toktogul was derived as follows:

Separable cost for energy	=	$ 1070 thousand
Joint cost	=	2680 thousand
Total	=	$ 3750 thousand

The separable energy cost is 28% of the total (1070/3750); therefore, 28% of the joint cost was allocated to energy in addition to the separable cost. The remaining joint reservoir cost was allocated to water supply. The resulting joint reservoir costs allocated to energy are presented in Table 5.

Table 5: Derivation of Joint Reservoir Costs to be Allocated to Energy

		($ thousands)	Reservoir costs allocated to energy ($ thousands)
Toktogul:	Energy facilities	1070	
	Reservoir	2680	28% allocated to energy = 750
	Subtotal	3750	
Andijan:	Energy facilities	89	
	Reservoir	313	22% allocated to energy = 69
	Subtotal	402	
Kayrakum:	Energy facilities	112	
	Reservoir	487	19% allocated to energy = 93
	Subtotal	599	

Charvak:	Energy facilities	534	
	Reservoir	306	64% allocated to energy = 196
	Subtotal	840	
Chardara:	Energy facilities	89	
	Reservoir	802	10% allocated to energy = 80
	Subtotal	891	

8.3.1 Allocation of O&M Costs to Energy and Water Supply

The resulting allocation to purposes served, energy and water supply is presented in Table 36. It was assumed that the conveyances serve only water supply; therefore, all of the $4740 thousand estimated O&M costs for conveyances were allocated to water supply.

Table 6: Allocation of Annual O&M Costs to Energy and Water Supply

Description	Separable Costs ($ 1000)	Joint Costs ($ 1000)	Total Costs ($ 1000)
Allocation to energy			
Toktogul	$ 1070	$ 750	$ 1820
Andijan	89	69	158
Kayrakum	112	93	205
Charvak	534	196	730
Chardara	89	80	169
Conveyances	0.0	0.0	0.0
Subtotal	$ 1894	$ 1188	$ 3082
Allocation to water supply			
Toktogul	$ 0.0	$ 1930[a]	$ 1930
Andijan	0.0	244	244
Kayrakum	0.0	394	394
Charvak	0.0	110	110
Chardara	0.0	722	722
Conveyances	4740	0.0	4740
Subtotal	$ 4740	$ 3400	$ 8140
Total cost allocated to purposes	$ 6634	$ 4588	$ 11222

b. Reservoir costs minus joint energy cost ($2680 - $750). See pages 10 & 11 and Table 5 for the derivations of the numbers in this column.

8.3.2 Allocation of Water Supply Costs to the Republics

The allocation of water supply O&M costs to the republics was based on the historical water shares received by each republic in percentage of total supply (8, p. 112, Table 10.2) The allocation to the republics of the $8140 thousand of allocated water supply O&M costs is presented in Table 7.

For energy, the costs were assumed to be accurately reflected in the rates charged for energy. The allocation of the $3082 thousand in energy costs to the

Republics are presumed to be accounted for in the rate structure for energy delivered to each Republic. Therefore, they are no longer a component of this allocation process.

Table 7: Allocation of Annual Water Supply O&M Costs to the Republics

Republics	Historical shares of Water Deliveries (%)	Allocated Costs ($ thousands)
Kyrgyz Republic	5.0	$ 407
Tadjikistan	7.5	611
Uzbekistan	57.3	4664
Kazakhstan	30.2	2458
Total	100.0	$ 8140

9.0 Strategy For Adequate O&M Funding

Maintaining national sovereignty is usually of major concern in transboundary water supply situations. Maintenance of both sovereignty and adequate levels of funding can be assured by putting transboundary water management agreements and associated payments on a government-to-government basis. In so doing, the respective republics become intermediary water suppliers.

The republics are the direct recipients of the transboundary water which they, in turn, deliver to the final water users within each republic. Therefore, international financial obligations associated with the transboundary system should be met by the respective governments. That is, the funding for transboundary facilities should be paid entirely out of the respective state budgets. How the respective republics recover those costs from the water users in their republics is an internal matter subject to their own water pricing policies.

It is extremely important that the payments made by the Republics to support O&M of the transboundary facilities must, in fact, be available for that use. Monies deposited in accounts that are vulnerable to the vagaries of any political process often get siphoned off for other purposes. To protect against that possibility, it is recommended that payments of allocated O&M costs should be made to a secured account in a major international bank. Let the term "secured" be interpreted that deposits in that account can not be removed for any reason other than for O&M of the identified transboundary facilities. That account should be subject to periodic audit by an independent auditor with high international standing and the audit should be made public.

It should be expected that there would be incidental costs associated with administering the secured bank account and for audit services that would have to be met.

10.0 Conclusions

Principles for sharing O&M costs of water facilities having interstate joint use indicate that funding should come entirely from the respective state budgets with each state government acting as an intermediary supplier of water to water users within their own republic. The degree to which those state-budget provided costs are recovered from the water users within each Republic is an internal matter for each Republic to deal with according to their own water pricing policies.

It does appear that each republic is now in the process of phasing in water pricing policies to cover at least part of the cost of providing water supply and delivery services. However, to date during the transition to market economies, water users ability to pay is not sufficient to cover charges, so the republics are phasing in water pricing policies over a few years. (9)

Cost sharing on operation, maintenance, capital repair and reconstruction of the facilities should be in proportion to the water received. The model for cost allocation presented herein should provide a useful illustration of how O&M costs of supplying transboundary water can be allocated among the receiving Republics.

Resolution of the issue of adequacy of funding of O&M of the transboundary facilities and allocation of those costs to the republics depends on a reasonably accurate assessment of the condition of those facilities. Are they, in fact, in a severe state of deterioration? If so, what is a reasonably reliable level of financing that is needed for the repairs necessary to bring the facilities to effective and efficient levels of performance? These are questions that must be answered before any responsible attempt at meeting the financial need can be made, including allocation of O&M costs.

There is a need for an on-site engineering assessment of the conditions of the facilities, the level of operation required to sustain effective service, and estimated cost of that level of operation. A review of the O&M cost estimates developed in the annual budgeting process would be a good place to start such an assessment. It is likely that implementation of the recommendations stemming from such an assessment would require financial assistance from international sources. Therefore, to ensure objectivity, the team to conduct such an assessment should include international experts with experience in the operation and maintenance of major water supply and delivery systems and associated hydro-power facilities.

11.0 Recommendations

- A joint team of knowledgeable local experts and highly qualified third-party engineering experts in O&M should be employed for the following purposes:
    1. Conduct an objective assessment of the condition of the transboundary facilities.
    2. Identify the level of financial effort required, if any, to bring those facilities to acceptable levels of operation.
    3. Delineate a level of continuing O&M activities necessary to ensure sustainablility of an acceptable level of operation.
    4. Specify the organizational structure, resources needed, and operating procedures for an entity to carry out those activities which should include a preventative maintenance program as well as operation and repairs.

- Conduct a seminar on cost allocation. Possibly one regional one with selected representatives from each republic attending or smaller separate ones in each republic. I do not have a good feeling for which would be better. Whatever venue is used, the attendees should have at least one example case study to assess that is applicable to their location.

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