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# IMPACT OF HYDEL POLICY ON THE POWER TARIFF IN PAKISTAN

BY

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## INTRODUCTION

Policy decision making in Pakistan has suffered due to hasty, adhoc, politically motivated methods which has resulted in considerable loss to the country. This equally applies to the Hydel Policy.

### I. Net Profits from Tarbela Dam Power Station

Article 161 (2) of the constitution of Islamic Republic of Pakistan is quoted below :

"The net profits earned by the Federal Government, or any undertaking established or administered by the Federal Government, from the bulk generation of power at a hydro-electric station shall be paid to the Province in which the hydro-electric station is situated."

The proper and reasonable interpretation of article 161 (2) is that this applies only to hydro-electrict-station and not to storage dams for replacement. Storage dams, such as Tarbela and Mangla were constructed for replacement of the Eastern Rivers water diverted to India, the revenues accruing from the power generated were rightfully to be used for maintenance of the barrages and link canals dependent for their supplies on these storages and also for the drainage of the areas affected by the link canals. According to the Indus basin development fund Agreement (Annex-D) it was agreed that the operation and maintenance costs of Indus basin works would be made available from the power revenues of Mangla and Tarbela Dams. Unfortunately this clause was lost sight of by the previous Government in a hasty decision to work out the royalty and net benefits from Tarbela dam. Ignoring financing of operation costs of Indus basin works has caused considerable loss to the area due to waterlogging. The irrigation department could not finance the heavy cost of maintenance of barrages, link canals and pumping of tube wells from its own revenues and as a result the whole irrigation system has deteriorated. Things have reached a stage

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now that the largest and best irrigation system in the world is being privatised as it cannot meet the operational expenses from its own resources.

A royalty of 6 Billion Rupees for NWFP from Tarbela Dam has been worked out without taking into account all these factors. This was done at the bureaucratic level without discussion with WAPDA and other irrigation experts by the previous Government for purely political reasons. A more serious situation may arise as Azad Kashmir is also demanding royalty from Mangla Dam. With these two royalties WAPDA may pass on the burden to the common man in the shape of surcharge which is very unfair. There is a hue and cry about power surcharge and 1500 writ petitions were filed in the Lahore high court by the affectees.

## II. Impact of High Power to Tariff on Economy

In an article in the "NATION" dated 30 December 1995 "WAPDA AN ECONOMIC INTERPRETATION OF HIGH COURT JUDGEMENT AND BEYOND" Dr.M.A. Hussain Mullick states :

"Most of these increases have taken place during past three years. For instance, the cost per KWh which stood at Rs 1.47 on household consumption (General Supply Tariff A-I) back in August 1992 had meanwhile risen to Rs 4.47 per unit (with a consumption of 2000 units) thus showing an increase of 204 percent. A high increase in electricity tariff is beyond the capacity of a middle level citizen. This is true because the per capita income of a Pakistani citizen has hardly shown any increase during the above three years. As such, the `balance' proposed while imposing the levies and fixation of rates by the authority, the increase announced in the schedule of electricity tariffs has definitely gone beyond the reach of a large number of citizens. Therefore, the high increase introduced by the WAPDA during 1992-95 has not only been arbitrary and unreasonable, but it has also been exorbitant.

WAPDA being a `commercial' organization has no right whatsoever to pass on the `investment cost' to the existing consumers. For this purpose, it must issue either bonds, borrow funds or resort to issuance of shares. It just cannot pass on the investment amount to the consumers. This is just not allowed no matter how desperate the situation may look like. It may be mentioned here that investment in hydel projects is generally a paying proposition

because hydel generation schemes do not require fuel and in addition they generally have a multipurpose character (also provide irrigation facilities).

Both Mangla and Tarbela projects are excellent examples to be quoted in support of the above thesis. It is reported that the present cost of electric generation by Mangla and Tarbela projects are close to nothing-7 to 10 paisas on KWh. There is one big advantage in respect of the hydel generation. A hydel plant may cost more but, it has virtually no generation cost.

The high and exorbitant levels can play havoc not only with the disposable income of the domestic consumers, they can also cause considerable damage to the competitiveness of Pakistan exports in the world market. For instance, how can Pakistan compete with the goods produced in Guangzou (China) where local industrialists are paying only 1.52 cent per one unit of KWh as compared to as much as 10 cents in Pakistan. Obviously such lapses on the part of WAPDA can cause irreparable damages to Pakistan's exporters to foreign countries. Even India's commercial consumers are paying less than that of Pakistan. Calcutta, for instance, pays only 6.91 cents per KWh as compared to Islamabad's 9.44 cents per KWh. Even Bangkok charges less: 6.77 cents per KWh. (Business Today, May 8 to 14, 1995, p.15).

At the end, it may also be mentioned that the WAPDA organization which holds assets worth Rs 280 billion has not been able to develop the desired quantum of electricity. This is evident from the fact that at present per capita consumption of electricity is about 300 KWh. This compares very unfavorably with the average electricity consumption on per capita basis for the Asia region as a whole which stands at 1,235 KWh.

a. Because of the inadequate generation of electricity, the WAPDA has been guilty of resorting to large-scale loadshedding. This has been happening during the past several years. It is estimated that this loadshedding has been causing a loss of $ 950 million per annum:

b. The WAPDA has a revenue in excess of Rs 85 billion, but the tragedy is that because of over-staffing, high overhead costs, inefficiency and the concomitant massive corruption, the expenditures have been rising faster than the revenue. The

result is that WAPDA has all the time been relying more on higher tariffs than on improving the overall efficiency. The result of this policy has been that the consumption of electricity has not been growing along with the imperatives of economic development.

The High Court judgment has, therefore, done a good job in pointing out the need for appointing a special commission to examine the working of the authority. It is from this exercise that a new institution (s) will be born to not only keep the tariffs reasonable but also to explore all avenues of generating electricity to meet the development requirements of the country.

Dr. Malik has correctly brought out the urgency for bringing in more multipurpose hydro-electric projects which produce cheap electricity. It may be stated here that a committee was appointed within WAPDA for restructuring it in the early eighties. This committee decided that the distribution wing of WAPDA should be transferred to the provinces as this is the most inefficient and corrupt wing of WAPDA. This would have left WAPDA to concentrate on generation particularly hydel power generation. This suggestion of WAPDA was not approved by the Federal Government. There has been too much interference in WAPDA affairs by the Federal Government though according to WAPDA charter it is supposed to be autonomous. The Federal Government never helped WAPDA in approval of projects nor provision of funds for survey, investigation and research. A long standing demand of WAPDA that Kalabagh Dam should follow Tarbela Dam was never approved. Even after the Revised Action Program for irrigated agriculture was completed in 1979 with the help of UNDP and World Bank which suggested that Kalabagh Dam is essential for irrigated agriculture and power, no action was taken by any Federal Government. The Martial Law Government which was all power full could have taken it up. The first people's party government though it opposed the project in 1988 but realized its importance later and in August 1990 it not only supported the Kalabagh Dam but other projects in the integrated water resource development program prepared by their minister of water and power and the present President. The Muslim League Government which followed this government did nothing for Kalabagh

Dam but gave a hasty approval to Ghazi Barotha Project which is a single purpose project. The defects of this project have been discussed in the Engineering Congress Paper No. 551 by the author of this paper. Another great disservice done to Kalabagh Dam by the Government is to divert the promised World Bank funds to this project. World Bank had categorically stated that they can either finance Kalabagh project or Ghazi Barotha Project.

## III. The High Cost of New Thermal Projects by Foreign Firms

The present Government signed a number of agreements with foreign firms for thermal power to overcome power shortage as soon as possible. A news item dated September 20th 1994 headlined " Power pacts to cost $ 1400 million more than world rates" in the NATION is quoted below:

In a statement issued on Sunday, Dr. Mubashir Hasan said as per newspaper reports, eight major agreements for the production of 3,498 megawatts of electrical power at an investment cost of 3,504 million US dollars were signed on September 24, 1994, at Islamabad. The cost of all these agreements, except one - the Jamshoro project is highly inflated.

The world rates of building complete thermal power plants of range between $500 thousand and $600 thousand per megawatt. Indeed the cost of the Jamshoro power house, included in the list is going to be $561 thousand per megawatt which may still be termed slightly on the higher side. However, the cost of a similar project based on natural gas, combined cycle is shown as $ 1,000 thousand per megawatt. The prices range between $561 thousand and $1,215 thousand per megawatt. The difference permitted is inexplicable. It should be noted that given the opportunity and the liberal concession allowed to foreigners, WAPDA is capable of building big power plants at a cost ranging between $400 thousand and $ 500 thousand per megawatt.

At an average high rate of say $600 thousand per megawatt, the cost of the projects signed on September 24, should not have exceeded $2,100 thousand against the amount $3,504 thousand, approved by the government. Thus there is an element of over invoicing, commissions and kickbacks, call them what you may, at least to the extent of $1,400 thousand, a monumental sale of the

interests of the peoples and governments of Pakistan and the United States.

Having recovered $1,400 thousand through back door, the real cost of the projects to the investors would be negligible, if any. The rest of the cost would be borne by the banks, to be ultimately paid by the consumer. Furthermore, these plants would produce a little more than 18 billion units of electrical power, annually, if their aggregate production is based as equivalent of 365 days a year and fourteen and half hours per day's production.

The Government has bound itself to pay the producers at the rate of 6.5 cents per unit, a scandalous rate as the cost of production shall not exceed three to three and a half cents per unit. With at least three US cents per unit, net, the new power generators would earn nearly $600 thousand annual profit. The chances are they would earn much more as the plants may run full capacity eighteen to twenty hours per day. All this amounts to a horrendous exploitation of the people by the industrialists of Pakistan and America under the patronage of their Governments.

## IV. Neglect of Hydel Potential by WAPDA

WAPDA has neglected vast Hydro Electric Potential on Indus and other rivers and mostly concentrated on Thermal power generation which has also increased the power tariff. No multipurpose dam was built since Tarbela more than 22 years back. In 1975 Vice President of World Bank Mr.David Hopper stated that WAPDA does not have power projects to be considered by the World Bank. He also stated that a small country like Bangladesh had a portfolio of 30 power projects ready. There has been a complete neglect of the projects for Hydro Electric power as it requires had work of survey, investigation as compared with Thermal projects.

In March 1975 a seminar was held by WAPDA for development of hydroelectric power. The Minister of Water and Power was the chief guest. In this seminar the author of this paper presented a paper on Kohala Hydro-electric project on Jhelum. Later the Neelum Jhelum addition was also suggested but none of these projects have been prepared fully. The only serious study carried out by WAPDA is the Hydel Ranking study by MECO which has proved a disaster as it tried to shelve Kalabagh Dam and instead proposed Bhasha which is an un-economical and dangerous site as can be

seen from Appendix-I enclosed. Instead of depending on foreign consultants WAPDA should have a strong in-house organisation to manage the hydel projects investigation and fixing priorities.

In 1977-78 the first report of the Revised Action Program by WAPD, the Bunji Hydro Electric Project was suggested in 1976. This was one of the best hydel sites in Asia. Bunji gives 800 feet drop with only 4.6 miles of tunnel. The power wing's only objection to Bunji project is that it requires long transmission lines to the grid but they supported the transmission of power from Tajikstan which is many times longer and passing through much more difficult terrian. After 20 years now WAPDA is taking up the investigation of Bunji project. A ranking study by Canadian Consultants MECO listed Bunji No.2 after Bhasha in the priority list and completely omitted Kalabagh Dam which was fully investigated and ready for construction (Please see Appendix-I).

In the Revised Action Program for Irrigated Agriculture prepared by WAPDA in 1979 with the help of World Bank and UNDP, two projects were included for storage and hydel power generation. Kalabagh Dam construction was to start in 1986-87. Another storage project of Thal Reservoir was given highest priority as this firms up the power generation at Tarbela particularly in the closure period of December and January. With this project the loadshedding in these months could be completely avoided. It is important to record here that this project was objected to by Government of Sindh and the project was referred to the then Prime Minister Mr.Z.A.Bhutto who cleared the project. A PC-I for this project was prepared in 1981. Construction of this project was to start as early as 1982-83 as per Revised Action Program but unfortunately even this project has not been taken up. If these projects had been taken up they would have not only helped considerably in reducing load shedding but also increased our agricultural production and saved the severe drain on our resources for import of food grains.

## V. Is Concensus Necessary for Taking up a Multipurpose Dam Project?

To reduce the burden on the common man preference should be given to Hydro Electric Projects particularly multipurpose dams such as Kalabagh Dam. Kalabagh Dam has been delayed for want of consensus between Provinces. It may be stated here that the concept of consensus for multipurpose projects was never followed

in the past in Pakistan. The following few examples are quoted below :-

i. In early fifties there was a tussle between Warsak Dam and Mianwali Hydro Electrict Project. The Federal Government decided to have Warsak Dam. There was a controversy between Guddu Barrage and Mithankot Barrage on river Indus. Mithankot Barrage was suggested by former Secretary Sindh Government Sir Thomas Foy in the interest of development of larger area of command of Balochistan and Cholistan but the Federal Government decided to have Guddu Barrage. Another interesting project which was proposed by the Punjab Government in early seventies was Thal reservoir which was objected to by Sindh Government. Former Prime Minister Zulifqar Ali Bhutto ignored the objections from Sindh and approved the project. A project PC-I was prepared in 1981. This has the great advantage of firming up power from Tarbela Dam particularly in the closure period of December, January.

A project is selected which has the maximum benefit to maximum number of people even if it hurts a small number. Every man made law is open to more than one interpretation and rightly so. That would be a bad day for democracy when there would be consensus all round. Consensus is the hall mark of despotism and not of democracy. Walter Lippman the famous American journalist has aptly described a despotic regime in these few words **"where all think alike no one thinks very much".**

All objections from Sindh and NWFP against Kalabagh Dam have been throughly examined by IBRD, WPADA, foreign consultants and even chinese.There is nothing to worry. The fears of Sindh Government that construction of storages upstream would affect their shares is ill-founded as Sindh has a share of 37.7 percent in all future storages besides the releases of extra water from storages would improve the quality of water as Sindh is getting affected due to its small share. IRSA has recently recommended construction of storages not only for better implementation of para-2 of Water Accord but also as it is essential to implement para 4 & 6 of Water Accord.

## VI. Conclusion.

To make cheap power available and reduce power tariff it is essential to go in for multipurpose dams. The selection of dams has to be done very carefully Appendix-I discusses some aspects of this. A very important point we should not forget is that we have given away our historic rights on three eastern rivers and replacement by storages in not a permanent arrangement. The essential factor of our future dams should be long life. Shyok and Skardu dams have very long life. Sluicing dams like Kalabagh, Chashma and Chiniot are ideal for long life. Tarbela and Mangla have a limited life so is Bhasha dam. There are some good run-of-the river projects on Indus and Jhelum for hydroelectric power generation which also need to be taken up.

## REFERENCES

1. Engineering Congress paper No.537 by Mohiuddin Khan 1990.

2. Engineering Congress Paper No.551 by Mohiuddin Khan 1994.

3. Statement by Dr.Mubashir Hasan dated 26 September 1994.

4. Article by Dr.M.A. Hassain Malik dated 30 December 1995.

## I. WATER AND POWER POTENTIAL OF UPPER INDUS

The upper Indus fed by glacial tributaries like shyok, shigar, Astor, Hunza and Gilgit is located in Baltistan and Gilgit areas known as northern areas of Pakistan. This is an important geostrategic area between China, India and the Soviet Russia. Some of the highest mountains and largest glaciers are located in this zone, out of the world's 50 high mountain peaks about 35, the famous K2 are situated in this area. The world's largest glacial range outside the polar region i.e. Siachin is located here which is 46 miles in length.

The Karakorum highway (KKH) connecting China and Pakistan was completed in 1978. It was opened to traffic in 1979. The road connecting Kashgar and Islamabad has an easy gradient of maximum 8% only which can carry heavy equipment and tanks. The road from Karakorum to Khaplu via Shardu is a 40 class road. Shardu is 150 Km. from the main Karakorum highway. The first 50 km of road from Karakorum highway to Skardu, no doubt, passes through difficult terrain as it follows the loop of Indus. During discussions with the Frontier Works Organization a tunnel to cut short this road was suggested but at that time the importance of the road did not justify this. A tunnel of 4.5 miles would get rid of this 36 miles of difficult road. In fact Montreal Engineering Co. who have studied power generation from this loop of the river upstream of Bunju had suggested 3 tunnels of 14 meters diameter. A tunnel for the road is fully justified when upper Indus dams and hydro electric projects are undertaken. The general misunderstanding that the northern areas are not accessable is no longer true.

The great potential for water and power in the upper Indus was known for a long time. The irrigation map of West Pakistan of 1960 indicates the Skardu dam site and the Bunji hydro electric site where a tunnel of 4.5 miles could give a drop of 800 ft on Indus. The first reconnaissance report on the upper Indus storages Skardu and Khaplu sites was prepared by HARZA in July 1962. The sites were visited by Engineers of WAPDA and HARZA who were preparing a master plan for water and power resources for Pakistan. HARZA report of July 1962 states that :

"The Skardu area from a physical stand point, is by far the largest open basin on the Indus above Tarbela dam site, with a capacity to store any quantity of water upto probably 40 million acre feet. The catchment areas is 44,000 square miles and the annual run off is estimated roughly at 45 million acre feet. The Skardu site possesses an important advantage over upstream alternative in that it would control all these major branches of Indus, the Shigar, the Shyok and the Indus itself. The Khaplu reservoir

site appears to have very favorable physical characteristics for development of a large scale storage. The only limitation appears to be the run off volumes of the Shyok river which is roughly estimated at 15,000,000 acre feet annually. Storage equal to the annual run off would require a dam of about 600 ft height which appears physically practicable. Such a reservoir would intercept much less silt than would a similar reservoir at Skardu since the inflow is only one third as gross and would accordingly have a much longer life. Development and population in the Khaplu Valley is considerably less than in the Skardu Shigar Valleys"

The above report is based on first visit without any survey and without any information but HARZA have done a great service in bringing out the potential of these sites particularly the Khaplu or Yugo site which was first identified by them. Montreal Engineering Company (MECO) prepared hydro-electric inventory and ranking report in 1985. In addition to the two storages of Khaplu or Yugo and Skardu they identified a new site at Bhasha in the Indus gorge just downstream of the border of Gilgit Agency. The Indus gorge downstream of Skardu was always considered as neither safe nor economical for high dams in the past.

| Sr. No. | Description | Unit | Yugo Dam | Skardu Dam | Bhasha Dam |
|---|---|---|---|---|---|
| 1. | Height of Dam | M | 165 | 230 | 200 |
| 2 | Width of Dam | M | 770 | 1,050 | 950 |
| 3 | Storage Live<br>Dead | $KM^3$ | 6.9<br>2.1 | 19.0<br>6.1 | 7.0<br>2.0 |
| 4 | Reservoir Area | $KM^2$ | 155 | 300 | 112 |
| 5 | Full Supply | M | 2,590 | 2,316 | 1,160 |
| 6 | Normal tail water level | M | 2,440 | 2,134 | 975 |
| 7 | Life of reservoir | Years | 300 | 400 | 80 |

It would be seen from the above statement that Skardu dam has almost thrice the live storage capacity of Bhasha and even Yugo dam has almost the same live storage as Bhasha with even a lesser height of dam. Skardu dam even with 200 M height, (same as Bhasha) yields a total storage of 20 KM3 against 9 KM3 for Bhasha. One of the greatest advantages of Skardu dam is that it is the only dam on Indus which can control the Indus flows to a considerable extent. This has excellent flood control benefits as Summer flows in Indus could be effectively controlled by Skardu dam and the water that is now causing in Indus could be effectively controlled by Skardu dam and the water that is now causing in the table indicates the life of the reservoir. It would be seen that Bhasha has a fraction of the life of Shardu and Yogu dams. The life of even 80 years is liberal for this highly seismic reach of Indus gorge as the large land slides could considerably reduce the life of the dam. An important point about Indus

storages is that these have to replace the supplies of the eastern rivers given away to India permanently and as no storage is permanent, the longer the life the better for us. The reservoir level of Skardu of 2316 M is above the Airport level of 2225 M. The Airport is 14 km downstream of Skardu town and is situated close to the river bank. In any case the airport has to be shifted to a site upstream say near the confluence of Indus and Shyok where hard levelground is available. Besides this would have the further advantage of being nearer to the line of control with India and also nearer to Siachin glacier. Submergence of areas in the Indus and Shigar due to Skardu reservoir need to be studied and the dam height adjusted to avoid flooding of any large cultivated and developed areas as far as possible. In any dam project submergence of areas is inescapable and has to be tolerated. In the case of Bhasha 100 KM of Karakurm highway would be submerged and the fertile vallies on either side of the river upto 100 KM. In the case of Mangla dam Murpur town had to be shifted.

MECO have overlooked some important factors in development of the hydro electric potential of the upper Indus, which are discussed below :

1. River development for storage should normally start from the upstream as storage water would be available for all hydro electric sites downstream. Storage on the downstream cannot help the hydro electric sites upstream like storage at Skardu can make available.
2. The Indus is steeper in the upper reaches particularly downstream of Skardu. The enclosed long section Appendix-A shows that the river has the steepest slope from Skardu to a point downstream of Bunji i.e. between km 2250 to km 2350 from the river mouth.
3. One of the most attractive site for hydro electric power development on Indus is on the loop upstream of Bunji where a tunnel of only 4.5 miles develops a drop of 800 ft. This coupled with the increased releases from the Skardu reservoir would make available one of the best hydro electric sites in Asia. MECO have recognised the great value of this site and have ranked this as NO.2 in their ranking study as can be seen from Appendix-II, but because their Bhasha storage is on the downstream this site looses its power potential to a considerable extent.
4. Another advantage of the upstream sites on the Indus is that the quantity of sediment would be much less and the life much longer.
5. An important feature of the dam sites in the upper reaches is that they require smaller size of diversion tunnels and smaller capacity of spillways.

## II. COMMENTS ON HYDRO ELECTRIC RANKING OF INDUS PROJECT BY MECO

Appendix-II indicates the ranking of various sties by MECO and Appendix-III Table 2-1 gives details of the first ranked site as Bhasha dam. as discussed in the previous sections Bhasha dam is very inferior to the other two sites viz Skardu and Yogu, as a storage Bhasha suffers from some other serious disadvantages the following are some:

1. There is no rock up to 55 meters in the foundation.
2. The dam is located in the seismic zone. According to the "Atlas on seismically and volcanism" (Swiss Reinsurance Co. 1978) which classifies areas of the world into four seismic zones. The 1840-41 land slide dam at site A (Bhasha) are located in the second most severe zone, rated as having "heavy exposure to earth quakes" please see Appendix-IV. During the period 1927-1983 there were 146 recorded events of Richter Magnitude 4.0 or greater within 200 km of Bhasha Dam.

3. The floods caused by bursting of a dam similar to the land slide dam of 1840-41 have been examined by MECO but they state that the dam would be over-topped by such floods only when it silts up after the first fifty years. They seem to depend on the rare frequency of the occurrence. An important point to be kept in mind is that a dam of 200 meters with considerable seepage through the fault zones could itself create movements in the dangerous Naga parbat slopes which were responsible for the disastrous land slide dam of 1840-41. This created a dam of 200 meters in the river i.e. of the same size as Bhasha. The dam then burst due to a flood wave from another land slide near Bunji upstream. This is why the Indus was avoided for dams in the past. There seems to be no justification whatsoever for taking risks for such a dam when we have better dams upstream and would further improve the excellent hydroelectric potential upstream of this dam. The first ranked site after Bhasha as per the consultants is Dasu dam which is located downstream of Bhasha. This dam is proposed to be 235 meters high and is 35 meters higher than even Bhasha. MECO seems to assume dams of 200 meters and above as normal in the Indus gorge. They do not seem to realise the severe problems of foundations on Indus, for much lesser height of dam like Tarbela we had encountered serious foundation problems. Unlike rivers in Europe and North America we have poor foundation under most of our dams, good foundation is an exception rather than a rule. This dam suffers from all the defects of Bhasha and some more as it is nearer to the seismic zones of Jaglot sycline and patan mantle thrust zone (please see Appendix-IV).

The second ranked site Bunji of index capacity of 1290 MW has already been discussed and should be in fact the first even before Bhasha or any other dam. It has great potential even as a run of the river site. In fact it was recommended in the preliminary hydro electric and water plan, prepared by WAPDA under the revised action program for irrigated agriculture in 1977-78 MECO have suggested a dam of 270 meters at Bunji site with no live storage as in the case of Dasu which is not at all justified. All that is required is to have a low dam and a tunnel to connect the neck of the Indus loop which can generate about 800 MW. This could be firmed up when storages such as Skardu upstream are completed. One objection raised against Bunki Hydel is that it is too far from the main grid. An important point to be noted about this is that the distance from Bunji to the national grid via kunhar valley is the same as the distance from the proposed Bhasha to Tarbela dam along the Indus. Another vital point about Bunji is that it is centrally located in the Baltistan and Gilgit agency and can supply much needed power to this area and Azad Kashmir along the Astor Valley and Neelum Valley to Muzaffarabad. We can even supply power to China via Khunjrab pass and Chitral via the Shandur pass. All these three areas are within 250 KM distance from Bunji. The power lines radiating from Bunji in these directions could energise the areas on the way which are the most backward in Pakistan. The cutting of trees, even valuable fruit trees in severe winter would stop with availability of cheep hydroelectric power and thus the environmental protection would be ensured. This will have profound effect on the welfare of the hill people. The large majority of these people now suffer from shortages of food and of fuel for cooking and warmth. They are often victims of tuberculosis anemias and other deseases of poverty. An excerpt from the report by a panel of international experts which included Dr.Roger Revelle, President Kennedy's Science Advisor and others in 1978 known as Indus Basin Research Assessment Group is enclosed as Appendix-V.

The next ranked site Thakot also suffers from the same defects as Dasu as it has a dam of 205 meters. In the low Thakot a dam is of 60 meters makes available a net head of 114 meters due to the cutting of the loop in the river. Same arguments as for Dasu apply to patan one great advantage of Thakot site is that it is close to Tarbela but without a storage upstream they may not be economically justified particularly if high dams are to be constructed at these sites,. The next site on Indus is Rakhiot which is located in the Indus Gorge close to the land slide of 1840-41. From the considerations of Index cost also with 0.097 $ per KWH which is high it is not a desirable project particularly as a dam of 140 meters is proposed with no storage. The last ranked site on Indus by MECO is yulbo which is about 89 KM upstream of Bunji. It is strange that Skardu dam has been ignored in the ranking though yublo which is 61 KM

downstream of Skardu dam has been included. Even at this site a dam of 140 meters is proposed with a index cost of 0.135 $ per KWH and a index capacity of 710 MMW. As Bhasha is downstream of the site this site has no benefit of releases from storage. In conclusion it may be stated that none of the sites identified by MECO except Bunji are economically feasible for Bunji was already identified by us. How come that an experienced and renowned firm like MECO has given no priority to the excellent storages of yugo and Skardu and the large hydro electric potential of the reach from Skardu to Bunji and selected a risky and uneconomical site like Bhasha and preferred the inferior hydroelectric sites mostly downstream of Bhasha. This shall be discussed in the next para as author of this paper had discussions in 1982 with MECO during formulation of studies as General Manager, Planning Water WAPDA.

In the very first presentation made by MECO about the potential sites on Indus they had overlooked Shyok dam identified by HARZA in 1962. The author of this paper objected to this. On 24-10-1982 a meeting was held in the room of Member Power, CIDA and MECO representatives discussed the status of the so called `Disputed' area of Baltistan Gilgit agencies as India may object to the construction of works in this areas as it is "disputed". The provisions of the Indus Basin Treaty were explained to them and it was made clear that India had no right to object to our construction of works on Western rivers, Indus, Jhelum and Chenab as these rivers' water were entirely allocated to Pakistan and it is India that has our permission for any work on these rivers in areas under their occupation. A copy of the Indus Basin Treaty was given to them and in one of the meetings the Pakistan Commissioner for Indus Waters was also present. It was made quite clear to them that Pakistan had sacrificed the there eastern rivers of Ravi, Bias and Sutlej for exclusive rights on the Western rivers. No country in the world had permanently surrendered the water rights as Pakistan did and this is why a clause exists in the treaty that Indus Basin treaty should not be quoted as a prcedent any future, International water Treaty. After the meetings a Note was put to Member (Power) by the author of this paper that the Consultants should not have any reservation about the disputed areas and should consider all sites on the Indus, Member (Power) noted on the file "I do not know why they undertook ranking study in the first instance. Any way I agree that we must select the actual first ranked site and must ask MECO to make sure of it" . A letter was issued by the author of this paper accordingly. Another serious lapse committed by the consultants was to suggest that Bhasha dam should be constructed instead of Kalabagh dam to ensure better power potential. WAPDA took strong exception to this as Kalabagh dam was in the final stages of investigation by international consultants whose investigations were being financed by UNDP and supervised by

IBRD. A letter was issued to MECO not to open the issue of Kalabagh dam at this stage and concentrate on their own ranking studies. Inspite of this the consultants in their final report 1985 gave alternatives with Kalabagh dam and without the Kalabagh dam for the ranking study. It is strange that MECO had such dislike for Kalabagh dam whereas renowned dam consultants Chas. To Main for IBRD Lifetink report of 1967 felt that Kalabagh dam is one of the best dams and is preferable to Tarbela dam as Kalabagh is one of the few dams in the world where sluicing of sediments is possible. Tarbela dam had to be built because the investigations at that site were more advanced and due to the limited time available for the completion of Indus basin works. Kalabagh dam could not be taken up. Another attractive feature in the case of Tarbela dam was supposed to be the off channel storages from it which had not later proved feasible. We all know the problems faced at Tarbela and the heavy cost we had to pay for it. Due to the diversion of the three eastern rivers to India, the need to augment supplies early was great before a major high dam on the Indus, the author of this paper suggested a low dam storage for about 3 MAF ant Chashma in 1962 and the proposal for this was presented in a paper for the Engineering Congress. This dam also was not approved by the Federal Government as the Chashma Jhelum Link had to be expedited. As this was an excellent site for a storage, the size of the project by providing the storage of 0.8 MAF in the Chashma barrage itself was approved with great difficult as the IBRD saw the advantages of this project, but the West Paksitan Government had to pay for the extra cost of raised barrage. This storage served a very useful purpose before the completion of Tarbela dam. Though the barrage was not operated as suggested in the paper it has served a useful purpose and has not silted up in one year as predicted by some of our engineers. It still has about half million acre feet storage.