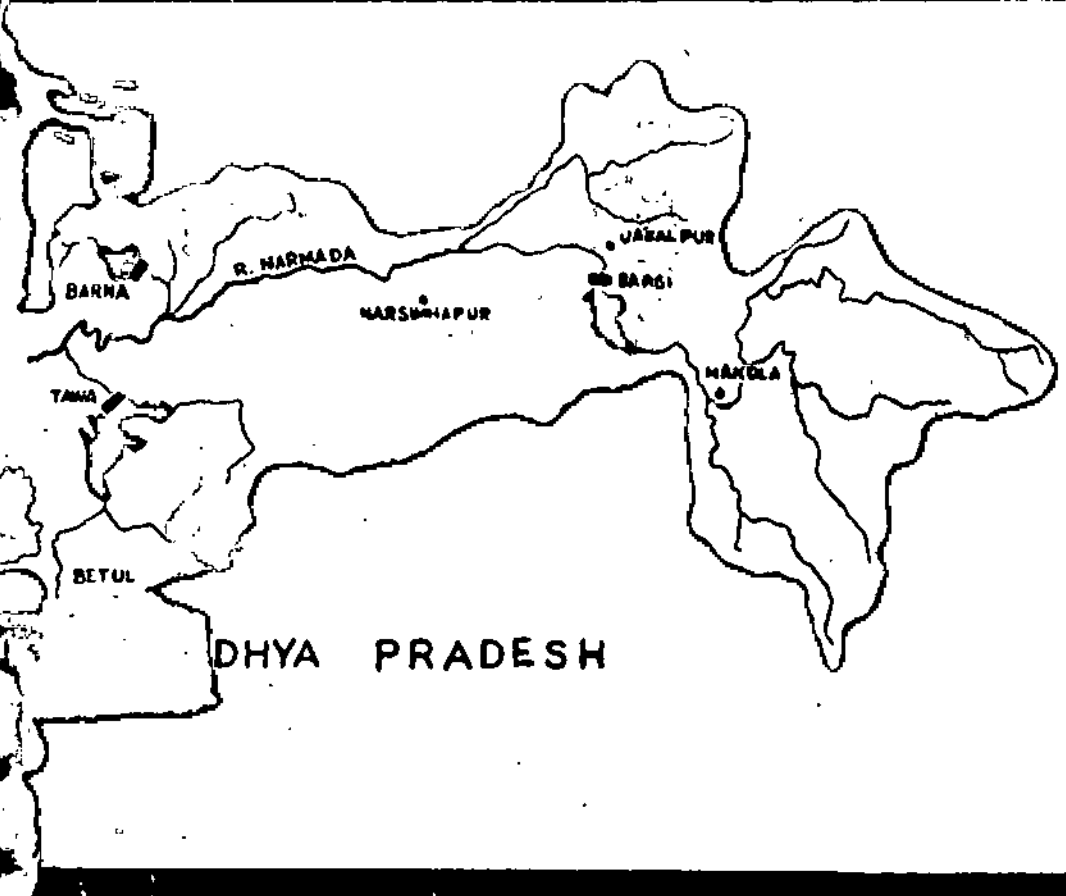
REPORT OF THE NARMADA WATER DISPUTES TRIBUNAL

VOLUME II



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GOVERNMENT OF INDIA
NARMADA WATER DISPUTES TRIBUNAL

THE REPORT OF THE NARMADA WATER DISPUTES TRIBUNAL WITH ITS DECISION

IN THE MATTER OF WATER DISPUTES REGARDING THE INTER-STATE RIVER NARMADA AND THE RIVER VALLEY THEREOF BETWEEN

1. *The State of Gujarat*
2. *The State of Madhya Pradesh*
3. *The State of Maharashtra*
4. *The State of Rajasthan*

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NEW DELHI

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VOL — II

TABLE OF CONTENTS

CHAPTERS

		Pages
X.	Full Supply Level of Navagam Canal offtaking from Sardar Sarovar, and its bed gradient	1—22
XI.	Determination of the Height of Sardar Sarovar Dam	23—48
XII.	Geological and Seismological Aspects of Sardar Sarovar Dam Site	49—51
XIII.	Height of Navagam Dam—Examination of the alternative proposals of Madhya Pradesh and Maharashtra	52—61
XIV.	Distribution of Costs and Benefits	62—85
XV.	Downstream benefits—Question of payment by Gujarat to Madhya Pradesh	86—98
XVI.	Directions to Madhya Pradesh, Gujarat and Maharashtra as regards submergence, land acquisition and rehabilitation of displaced persons	99—107
XVII.	Allocation of Cost of Sardar Sarovar Project	108—114
XVIII.	Directions regarding setting up of Machinery for implementing the decisions of the Tribunal	115—121
XIX.	Order as to Costs and other incidental matters	122
XX.	Final Order and decision of the Narmada Water Disputes Tribunal	123–135

STATEMENTS

		Pages
Statement 11.1	Inflow series for Sardar Sarovar Dam site in Chronological order	35
Statement 11.1A	Inflow series for Sardar Sarovar Dam site arranged in ascending order	36
Statement 11.2	Inflow series for Narmadasagar Dam site in Chronological order	37
Statement 11.2A	Inflow series for Narmadasagar Dam site arranged in ascending order	38
Statement 11.3	Inflow series for the catchment between Narmadasagar and Sardar Sarovar Dam sites in order	39
Statement 11.3A	Inflow series for the catchment between Narmadasagar and Sardar Sarovar Dam sites in ascending Chronological order	40
Statement 11.4	Use by Madhya Pradesh above and below Narmadasagar	41
Statement 11.5	Water available below Maheshwar	42
Statement 11.6	Total requirement of water for providing 28.00 MAF of 75% dependability taking into Account evaporation losses and regeneration	43
Statement 11.7	Carryover requirement for securing 29.29 MAF at 75% dependability	44
Statement 11.8	Carryover storage at and above Narmadasagar	45
Statement 11.9	Monthly withdrawal of water from Sardar Sarovar by Gujarat	46
Statement 11.10	Monthly requirement of water at Sardar Sarovar	47
Statement 11.11	Working Table of Sardar Sarovar	48
Statement 13.1	Power generation at Jalsindhi with FRL +420	5
Statement 13.2	Power generation at Sardar Sarovar with FRL +455 with Navagam Canal FSL +300	58
Statement 13.3	Power generation in early stage of irrigation development	59
Statement 13.4	Power requirement for pumping to bring the command area of +190 canal to the Status of +300 canal	60
Statement 13.5	Power generation at Jalsindhi with FRL +455 and Sardar Sarovar FRL +309	61
Statement 14.1	Comparison of power and energy produced at different stages in the National Jalsindhi and Sardar Sarovar Power Complex	70
Statement 14.2	Proposed distribution of power benefits of Sardar Sarovar between three States, Madhya Pradesh, Maharashtra and Gujarat	71
Statement 14.3	Comparison of cost of power generation in Jalsindhi and Sardar Sarovar	81
Statement 15.1	Monthly working table for Narmadasagar for meeting irrigation requirement in Madhya Pradesh	93
Statement 15.2	Reduction in benefits from Sardar Sarovar FRL +455 without regulated releases from Narmadasagar	94
Statement 15.3	Storage requirement of Sardar Sarovar without regulated releases	95
Statement 15.4	Cost of Sardar Sarovar Dam	96
Statement 15.5	Credit by Sardar Sarovar for regulated releases from Narmadasagar	97—98

ANNEXURES

		Pages
Annexure X-1	Extra annual cost of Lift Irrigation	15
Annexure X-2	Observations of Sediment data of the Narmada River	16—18
	Statement 1—Observed suspended sediment of river Narmada at Garudeshwar	17
	Statement 2—Observed suspended sediment of river Narmada at Mortakka	18
Annexure X-3	Silting of the Reservoirs at Jalsindhi and Sardar Sarovar	19—20
Annexure X-4	Some of the important lined canals, constructed in India, showing the bed gradients provided	21
Annexure X-5	Statement of area served by flow and lift as per different proposals	22
Annexure XI-1	Regenerated Inflows	30–31
Annexure XI-2	Silt deposition in Sardar Sarovar	32
Annexure XI-3	Flood Moderation by Madhya Pradesh Reservoirs	33—34
Annexure XIV-1	Regulated flow past Jalsindhi at different stages and the canal and river components	72—73
Annexure XIV-2	Tail water levels of Jalsindhi MDDL and average head for power generation of the canal and river components	74—75
Annexure XIV-3	Power generated at different stages in the notional Jalsindhi project and the energy produced	76
Annexure XIV-4	Regulated flow past Sardar Sarovar and utilisation of canal Head Power House and River Bed Power House at different stages	77
Annexure XIV-5	Tail water level of Sardar Sarovar CHPH and RBPH, MDDL and average operating Heads in the two Power Houses at Sardar Sarovar at different stages	78
Annexure XIV-6	Power generated at different stages at Sardar Sarovar Power complex and the energy produced	79
Annexure XIV-7	Share of Power between Madhya Pradesh and Maharashtra as per agreement of Jalsindhi Project	80
Annexure XIV-8	Cost of energy/KWH at Sardar Sarovar Power complex at different stages	82—84
Annexure XIV-9	Cost of energy per KWH in Jalsindhi Project	85
Annexure XVI-1	CMP No. 10/78—Statement by Union of India	107
Annexure XVII-1	Letter of Govt. of India, Ministry of Irrigation & Power No. 1(6)/62-Policy dated 17-4-67 regarding apportionment of cost and allotment of reservoir storage space in multipurpose projects	110—111
Annexure XVII-2	Use of water from Sardar Sarovar for irrigation and power generation	112—113
Annexure XVII-3	Evaporation loss from reservoirs after 10 years of commencement of construction of Narmadasagar and Sardar Sarovar dams	114

CHAPTER X

FULL SUPPLY LEVEL (FSL) OF NAVAGAM CANAL OFF-TAKING FROM SARDAR SAROVAR, AND ITS BED GRADIENT

Previous History

10.1.1 During 1956 a report on the Broach Irrigation Project in the erstwhile Bombay State was prepared by the Central Water and Power Commission (CWPC), Government of India. This scheme comprised a weir across Narmada river at Gora, with a canal off-taking on the right bank to provide for annual irrigation of 10.97 lakh acres in a gross commanded area of 13.3 lakh acres from the head of the canal upto Mahi river. In 1957, the concerned Member of CWPC suggested shifting of the site of the weir 2.5 km. upstream, and also provision of a high level canal to irrigate areas in the Mahi and Sabarmati basins in Gujarat which was part of the erstwhile Bombay State at the time. The Broach Project was modified, vide Exhibit G-176. The low-level canal was proposed with FSL 158.4, with the crest of the weir at RL 160. The bed gradient of the canal was proposed as 1 in 10,000 upto Miyagam branch, and 1 in 8,000 thereafter. A high-level canal, called Great Narmada Canal was proposed under Stage II, with FSL 295 and a bed gradient of 1 in 7,000 for commanding a gross area of 9.4 lakh acres. This canal was proposed to tail off at the Mahi Right Bank Canal at the off-take of the Shedi branch. The project report also indicated the possibility of extending the high level canal further upto Kandla port to meet the needs of water supply of the port. That was, however, to be investigated in the second stage.

10.1.2 The modified project report, Exhibit G-176, was referred by the CWPC to the Government of erstwhile Bombay State for its observations. The Government of Bombay State while accepting the broad features of the project, suggested certain modifications, as per Exhibit G-69, regarding lining of the proposed Canal, raising of the crest of the weir at RL +162, modifying spillway capacity, cropping pattern and provision for power generation. The project estimate was also recast in the light of figures of cost of similar projects in the State. Provision for wider foundations for the subsequent raising of the dam upto +320 was also made. The FSL of the canal was also worked out as +275 with a bed gradient of 1 in 10,000. The crest level of the dam adopted was +320 on the basis of tail water level of Harinphal project.

10.1.3 This modified project was then referred to a panel of Consultants by the Ministry of Irrigation and Power. The Consultants, in their report of April, 1960 (Exhibit G-382), made an important suggestion that the two Stages of the construction of the dam should be combined into one, and the dam built to its full height in the very beginning.

10.1.4 The new State of Gujarat was created on 1st May, 1960. On the 5th August, 1960, the Stage I of the above proposed project was approved by the Planning Commission, Government of India (Exhibit G-6). This provided for the construction of a dam with FRL 162, but with wider foundation for raising the dam subsequently to FRL +320. The second Stage of the project, which included the high level canal, was, however, not approved.

10.1.5 Administrative approval to Stage I of the project was accorded by the Government of the newly formed Gujarat State in February, 1961, and the project was inaugurated by the late Prime Minister, Shri Jawahar Lal Nehru, on the 5th April, 1961. The construction of the approach roads, colony, etc. was taken up, but the construction of neither the dam with wider foundations, nor the canal with FSL 158.4 was taken up.

10.1.6 In August, 1963, a brief report on Narmada Project was prepared with FRL +425 (Exhibit G-183). According to this project, it was proposed to provide only a high level canal with FSL +295. A Stage III was also provided to include reclamation of Little Rann of Kutch and for irrigation of seasonal crops therein. It also provided irrigation by lift to 7.5 lakh acres in Saurashtra, Kutch, etc. However, this canal was not shown as going upto Rajasthan, as per Map, vide Exhibit G-183, Vol. II.

10.1.7 Subsequently, in January 1965, Gujarat submitted a Technical Memorandum (Exhibit G-369) to the Khosla Committee (hereinafter called NWRDC) in which the dam at Navagam was proposed to be constructed to FRL +490. A canal off-taking from this dam was proposed with FSL +300. By a separate Memorandum (Exhibit G-180), Gujarat proposed to extend reclamation and irrigation to the Great Rann of Kutch and Banni areas. The reason for not providing for a higher level FSL than +300 for the canal is stated as under :—

> "The additional areas which can be commanded by raising canal off-take above RL 300 are comparatively limited on account of the steep rise in the general ground levels above this contour. Besides, the proportion of the CCA to the gross area in the belts between RL 300 to RL 350, and RL 350 to RL 400 is also less, since a sizeable portion of the area lies in hilly region of poor soil and very uneven topography. The cost of the canal in this area will also be higher since it would be running through highly undulating country for the first about 100 miles."

10.1.8 The Rajasthan Government, in their Note dated 17-12-1964, submitted to NWRDC (Exhibit R-104) stated that the lands in the State lying to the north of Gujarat border, had no source of irrigation,

and could be irrigated only if supplies were given from the Narmada river or from the Mahi river. According to the level at which the Navagam +300 canal could deliver water at the Rajasthan-Gujarat border, i.e., at about RL +100, it could command only about 1.8 lakh acres of gross area, and do actual irrigation of one lakh acres in Rajasthan, but if the canal could be taken out at a higher level from Navagam, larger areas could be served. According to Rajasthan, the Mahi canal from Kadana, with Full Supply Level at its head of +380, would deliver water to their borders at about RL +300, and command a gross area of about 11.5 lakh acres, inclusive of the 1.8 lakh acres proposed to be irrigated from Navagam +300 canal.

10.1.9 The Maharashtra Government, in its Memoranda of February and June, 1965, to the NWRDC (Exhibits MR-32 and MR-16), contended that the Sardar Sarovar dam should have FRL of about +210, and with the canal off-taking at about +190/185. According to Maharshtra, this lower canal could command the greater part of the area proposed to be irrigated by the +300 canal, while the rest of the area could be served by transferring the Mahi area, lying to the left of the low-level canal, to the Narmada command and releasing corresponding quantity of Mahi waters for irrigating lands between+300 canal and the +190/185 canal, and partly by lifting water from the lower canal for irrigating the higher areas. This canal was proposed with a bed gradient of 1 in 12,500.

10.1.10 The Chairman, NWRDC, desired that Gujarat may prepare a Study of the feasibility and economics of having two canals off-taking from Navagam, with FSL 300 and +210, respectively, versus one canal with FSL +300. In this Study (Exhibit G-184), Gujarat was of the view that one canal at +300 was preferable.

10.1.11 The NWRDC recommended in its Report dated 1st September 1965 that the canal may be taken with FSL +300, and include areas of Little Rann of Kutch, Great Rann of Kutch, Banni, and about 1.8 lakh acres of Rajasthan in the command of this canal. This proposed canal had a bed-gradient of 1 in 10,000 upto off-take of Banni Branch at mile 262, and further on a bed gradient of 1 in 6,000, and it was expected to reach Rajasthan border at about RL 100.

Statement of Case by the Party States before the Tribunal

10.2.1 As per para 56 of Volume I of the Statement of the Case of Gujarat, under the heading 'Navagam Canal and its commanded area', the FSL of the proposed Navagam canal has been proposed by Gujarat as +300. It should be mentioned that this proposed FSL is at the head of the canal, which is about 7 km from the right flank of Sardar Sarovar Dam, and four ponds lie between the dam and the head regulator of the canal. These ponds provide for fluctuation in generation of power at the canal head power house and, according to Gujarat's original Statement of the Case, the FRL of the pond at the off-take from Narmada river would be +320.

10.2.2 Gujarat has given proposals for the gross and culturable area to be commanded by this canal. The bed-gradient of the proposed Navagam Canal has been proposed by Gujarat as 1 in 10,000 upto the off-take at the Banni Branch at mile 262, and 1 in 6,000 thereafter.

10.2.3 Allowing for loss of head at the different structures on the canal, the FSL of the canal at the Gujarat-Rajasthan border was estimated as 99.47.

10.2.4 The bed-gradient of the Navagam Canal, which is to be lined, has been selected by Gujarat to attain a maximum velocity of flow in the canal upto a limit of 2 meters (6.56 ft.) per second to reduce the section of the canal in the interest of economy in the cost of the canal.

10.2.5 It has been mentioned in para 56.4 of Volume I of the Statement of Case of Gujarat, that for crossing of the natural topographical depressions by the Banni branch and the Saurashtra branch canals, it is proposed to have an artificial 'fall' where the canal enters a depression and a 'lift' at the other end of the depression. It can be assumed that these branches would cross the depressions in high filling without having first to drop and then lift the water. The areas beyond the depressions are, therefore, taken to be flow or lift areas in part as originally conceived. The fall and lift device is mainly a matter of a economics of the alternative proposals to cross the depressions.

10.2.6 Madhya Pradesh has objected to the Navagam Canal being any higher than with FSL 190, as that would involve submergence of Madhya Pradesh territory, and loss of power potential of Madhya Pradesh.

10.2.7 In para 5.25 of Volume V of the Statement of the Case of Maharashtra, Maharashtra has proposed FRL 210 for Sardar Sarovar Dam, and FSL of the canal at the off-take as 190. According to it, the Canal would be able to command by flow a gross area of 66.21 lakh acres and, in addition, a substantial area by practicable lifts in Gujarat. After giving other reasons, Maharashtra State prays that the Tribunal may disregard any proposal of a canal with FSL higher than 190, or of the Sardar Sarovar Dam with FRL higher than RL 210. The bed-gradient of the canal proposed by Maharashtra therein was 1 in 12,500, and overall gradient of 1 in 10,000, including losses at the works on the canal.

10.2.8 In para 5.05 of Volume I of the Statement of the Case, Rajasthan put forward the claim for waters both from +300 Navagam canal and the high level canal off-taking from Kadana Dam with FSL +380. It has requested that the quantity of water released by transfer of the existing Mahi canal areas to Narmada canal command, as proposed by the NWRDC may also be given to it, but that would suffice for only about 7.25 lakh acres of CCA and the remaining 7.44 lakh acres would have to depend on the Narmada canal. Rajasthan suggested that this canal taking off at FSL 300 or higher from Sardar Sarovar Dam, and with appropriate design, could deliver the water at the Rajasthan border at a suitable level to command an area of 7.44 lakh acres.

Decision of the Tribunal dated 23rd February, 1972 regarding the Legal Status of Rajasthan and the subsequent agreement of the party States dated 12-7-1974 making allotment of Narmada water to Rajasthan :

10.3.1 After hearing the Counsel of the party States, the Tribunal gave a decision on the preliminary issues, vide Judgment of 23rd February, 1972 (page 10). Two issues i.e., 2(b) and 3, framed by the Tribunal, were as follows :—

Issue 2(b) : That no part of the territory of Rajasthan is located within the Narmada basin or its valley.

Issue (3) : Is the State of Rajasthan not entitled to any portion of the waters of the Narmada basin on the ground that the State of Rajasthan is not a co-ripartan State, or that no portion of its territory is situated in the basin of the river Narmada ?

10.3.2 The decision of the Tribunal states :—

"Our conclusion, therefore, is that the State of Rajasthan is not entitled to any portion of the waters of Narmada basin on the ground that the State is not a co-reparian State, or that no portion of its territory is situated in the basin of river Narmada."

10.3.3 Subsequently, the Chief Ministers of Madhya Pradesh, Maharashtra, Rajasthan and the Adviser to the Government of Gujarat arrived at an agreement on a number of issues on the 12th July, 1974. Paras Nos. 3, 4 and 8 of the agreement, as given at page 10 of the judgment of the Tribunal dated 8-10-1974 are as below :—

"3. that the quantity of water in Narmada available for 75 per cent of the year be assessed at 28 million acre feet, and that the Tribunal in determining the disputes referred to it, do proceed on the basis of that assessment."

"4. that the requirements of Maharashtra and Rajasthan for use in their territories are 0.25 and 0.5 million acre feet, respectively, and that the Tribunal, in determining the disputes referred to it, do proceed on the basis that the requirements of Maharashtra for use in its territories are 0.25 million acre feet and that Rajasthan will get for use in its territories 0.5 million acre feet without prejudice to the height of the canal."

"8. that the level of the canal be fixed by the Tribunal after taking into consideration various contentions and submissions of the parties hereto."

10.3.4 By its judgment of 8th October, 1974, the Tribunal recorded the compromise of the party States as follows :—

"As a result of this agreement Rajasthan has now become entitled to a share of Narmada waters to the extent of 0.5 million acre feet.

** ** **

We, therefore, accept the agreement of the parties in this regard and we decide that Rajasthan is entitled to a share of 0.5 million acre feet of Narmada waters as a result of the agreement of the party States dated 12th July, 1974."

Relevance of the agreement dated 12th July, 1974, on the Question of the FSL of Navagam Canal

10.4.1 At this stage, it is necessary to deal with the argument of Maharashtra and Madhya Pradesh that in determining the question of the FSL of the Narmada Canal, the allocation of 0.5 MAF to Rajasthan is not a relevant consideration and ought not be taken into account. In support of this argument, reference was made to clause 4 of the Agreement dated 12-7-1974 Ex. C/1, which states : "that Rajasthan will get for use in its territories 0.5 MAF *without prejudice to the height of the canal."* The argument stressed on behalf of Maharashtra and Madhya Pradesh is that the level of the Narmada Canal cannot be decided by the mere fact that 0.5 MAF of water was agreed to be given to Rajasthan for use in its territories. It was submitted that the Agreement does not indicate in what manner Rajasthan was to get for use in its territories 0.5 MAF of Narmada water and it was open to the Tribunal to say that Rajasthan should get its allocation of water from the High Level Kadana Canal and Gujarat should be given an equivalent quantity in exchange from out of Narmada waters. (See Maharashtra Note 8 and page 1 of Maharashtra Note 53).

10.4.2 We are unable to accept the argument of Maharashtra and Madhya Pradesh. The reason is that clause 8 of the Agreement Ex. C-1 provides that "the level of the Canal should be fixed by the Tribunal after taking into consideration various contentions of the parties thereto", namely, Rajasthan, Gujarat, Madhya Pradesh and Maharashtra. If clause 4 of the Agreement is construed in the manner contended for by Maharashtra and Madhya Pradesh, clause 8 would be deprived of all meaning and content and rendered nugatory. It cannot be supposed that such a consequence was contemplated by the parties. It is, on the contrary, well established as a matter of law that an agreement must beread as a whole in order to ascertain the true meaning of its several clauses and the words of each clause must be so interprete das to bring them into harmony with the other provisions of the agreement as far as practicable. [Lord Davey in N. E. Ry. v. Hastings (1900) A.C. 260(269)]. It is also well established that in construing these clauses, it is legitimate to take into account the surrounding circumstances for ascertaining the intention of the parties. (See[1] Jessel M.R. in Cannon v. Villars and[2] Lord Blackburn in the River Wear Commissioners v. Adamson. In a recent decision *of the House of Lords, Prenn* v.

[1] (1878) 8 Chancery Division page 415 at page 419.

[2] (1877) 2 Appeal Cases page 743 (at page 763).

Simmonds, (1971) (3) *All England Reports* 237 @239-240, Lord Wilberforce said that in construing an agreement it must be placed in its context :—

> "The time has long passed when agreements, even those under seal, were isolated from the matrix of facts in which they were set and interpreted purely on internal linguistic considerations. There is no need to appeal here to any modern, anti-literal, tendencies, for Lord Blackburn's well-known judgment in River Wear Comrs v. Adamson[3] provides ample warrant for a liberal approach. We must, as he said, enquire beyond the language and see what the circumstances were with reference to which the words were used, and the object, appearing from those circumstances, which the person using them had in view."

10.4.3 At the time the Agreement Ex. C-1 was entered into, the party States were fully aware of the contents of the following documents :—

(1) Khosla Committee Report—G-83 ;

(2) Statement of Case of Rajasthan—Volume 6 ;

(3) Project Report filed by Rajasthan—R-71 ;

(4) Comments of Madhya Pradesh on the Khosla Committee Report—MP-165 ;

(5) Maharashtra Exhibit—Ex. MR-70.

In G-83, the Khosla Committee had recommended the allocation of 0.25 MAF to irrigate by flow an area of one lakh acres in Rajasthan by a canal taking off at +300 at Navagam reaching Rajasthan border at +100. In its Statement of Case, Rajasthan has claimed 2.2 MAF of water from Sardar Sarovar dam at +300 or above so as to command by flow an area of 7½ lakh acres (Volume 6, para 5.09 page 33). From this document, it is also clear that the water claimed by Rajasthan from Narmada was in addition to the water which would become available to Rajasthan from Mahi consequent on the Inter-State Agreement of 1966 (See Volume 6, para 3.22, page 26). In the Rajasthan Project Report Ex. R-71, the water requirement for irrigating areas in Rajasthan from Narmada was assessed as 2.18 MAF with irrigation by flow. The canal was anticipated to reach Rajasthan border at +175. In Ex. MR-17 filed before the Khosla Committee along with the letter of Shri G. N. Pandit, Maharashtra has stated that +190 canal could not provide flow irrigation to areas in Rajasthan and even a canal with FSL 300 would command only a gross area of 1.8 lakh acres, the actual irrigation being about 1 lakh acres. In its comments on the Khosla Committee Report Ex. MP-165, Madhya Pradesh has observed that the Khosla Committee's proposal to irrigate 1 lakh acres annually utilising 0.25 MAF of water would be possible only if the canal has a full supply level of +300 and any canal with lower full supply level at its head will not command areas in Rajasthan (see MP-165 para 4.2 page 7).

10.4.4 Construing the language of clauses 4 and 8 of the Agreement Ex. C-1 in the setting and background of these important facts, we consider that the true meaning of these clauses is that merely because 0.5 MAF of Narmada waters has been agreed to be given to Rajasthan, (a) Madhya Pradesh and Maharashtra will not be precluded from putting forward before the Tribunal their case of the FSL of the Narmada Canal +190 ; (b) nor will Rajasthan be precluded from arguing its claim for Narmada Canal for 300 FSL or above as claimed in its Statement of Case ; but (c) it is ultimately for the Tribunal to fix the full supply level of the canal after taking into consideration the various contentions of all the party States including Rajasthan.

Interpretation of the Agreement (Ex. C-1) dated 12th July, 1974

10.5.1 Two other matters were argued with regard to the interpretation of the Agreement (Exhibit C-1). It was contended in the first place by Madhya Pradesh and Maharashtra that both from the point of view of economy and technical feasibility, the grant of 0.5 MAF of water for irrigation in Rajasthan areas should not be from Narmada but should be served on exchange basis with Gujarat from the Mahi—Kadana complex through FSL 380 Kadana Canal. To put it differently, the arugment was that the Tribunal should direct Gujarat to supply 0.5 MAF of water to Rajasthan areas from the Mahi and not from Narmada and that in deciding the question of FSL of Narmada canal, the requirement of Rajasthan should not be taken into account. In our opinion, there is no warrant for this argument. Clause 4 of the Agreement (Exhibit C-1) clearly states that Rajasthan will get for use in its territories 0.5 MAF of water out of the 28 MAF assessed as dependable flow of Narmada. There is nothing either in Clause 4 or in other clauses of the Agreement (Exhibit C-1) to suggest that Rajasthan is to get 0.5 MAF of water out of Mahi—Kadana Canal Complex and not from Narmada. The general rule in interpreting treaties and agreements of any kind is that the terms which are used in the first instance are the only guide to the intention of the contracting parties and if these are clear and precise in themselves, it is not permissible to affix any other meaning to them than that which they naturally import. It is not hence competent for any party to depart from the exact terms of the agreement without the consent of the other parties[4]. As observed by the Permanent Court of International Justice in the case on the Acquisition of Polish Nationality[5] given in 1923 :—

> "The Court's task is clearly defined. Having before it a clause which leaves little to be

[3] (1877) 2 Appeal Case 743 @ 763 (1974—80) All ER Rep. 1 at 11.

[4] In this connection, we may refer to the famous maxim of Vattel :—
La premiere Maxime generale fur l'Interpretation est,—"qu'il n'est pas permis d'interpreter ce qui n'a pas besoin d'interpretation." (Droit de Gens LIV II Chapter XVII Section 263).

[5] Series B No. 7 at p. 20.

desired in the nature of clearness, it is bound to apply this clause as it stands without considering whether other provisions might with advantage have been added to or substituted for it."

In the *Jonge Josias*[6] Lord Stowell, after referring to the 'intent and meaning of the contracting parties' said later :

"For although the Court might be disposed to put a favourable interpretation upon the Articles of the Treaty, it is bound to construe them according to their natural and fair meaning, and not to impose upon the contracting parties stipulations which were never in their contemplation. The business of the Court is to expound and explain, not to frame original treaties."

Objection of Rajasthan to Maharashtra Proposal of Low Level Canal (MR-102)

10.5.2 It was next pointed out on behalf of Rajasthan that the canal proposed by Maharashtra (MR-102)—pp. 46,108 with FSL +190 and a slope of 1 in 20,000 reaches Rajasthan border at a level of 63.10 feet (and at a level of 38 feet with a slope of 1 in 12,500) and hence cannot provide for irrigation of Rajasthan areas or any portion thereof by flow. In MR-102 itself, Maharashtra has admitted that the canal with FSL +190 can provide irriagtion for Rajasthan areas only by lift and was not recommended as "being grossly uneconomical". But the argument of Maharashtra and Madhya Pradesh is that there is nothing in the Agreement (Exhibit C-1) to suggest that the intention of the parties was that Rajasthan areas were to be irrigated by flow and not by lift. We are unable to accept the argument of Madhya Pradesh and Maharashtra. Properly construed, clause 4 of the Agreement of 12th July 1974 (Exhibit C-1) means that Rajasthan is entitled to utilise 0.5 MAF of water from Narmada by a direct canal commanding a reasonable portion of Rajasthan areas by flow and not merely by lift. Any other interpretation of Clause 4 of the Agreement (Exhibit C-1) as contended for by Maharashtra and Madhya Pradesh would nullify the grant of 0.5 MAF of Narmada waters to Rajasthan and make it illusory and of no effect. The correct rule of interpretation applicable in this case is *ut res magis valeat quam pereat* often referred to as the rule of effectiveness. (See the opinion of International Court of Justice on "Acquisition of Polish Nationality" case, P.C.I.J. Series B, No. 7 at page 17).

10.5.3 As stated by Lauterpacht :

" ... The work of the Permanent Court has shown that alongside the fundamental principle of interpretation, namely, that effect is to be given to the intention of the parties, full use can be made of another hardly less important principle, namely, that the treaty must remain effective rather than ineffective. *Res magis valeat quam pereat*. It is a major principle, in the light of which the intention of the parties must always be interpreted, even to the extent of disregarding the letter of the instrument and of reading into it something which, on the face of it, it does not contain." [The Development of International Law by the Permanent Court of International Justice, pp. 69-70—quoted with approval by Mr. Justice Read in the Peace Treaties Case dated 28-7-1950—I.C.J. Series (1950) page 229 at 235].

10.5.4 In the Costa Rica Claims Commission[7] (Umpire Bertinnati) the rule of Vattel was stated that neither the one nor the other of the parties interested in the contract has a right to interpret the deed or treaty according to his own fancy (Vattel Chapter 17 section 265)[8]. Vattel's rule further cited by the Commission reads as follows :—

"It is not to be presumed that sensible persons in treating together, nor transacting any other serious business, mean that the result of their proceedings should prove a mere nullity. The interpretation, therefore, which would render a treaty null and inefficient cannot be admitted. It must be interpreted in a manner that it sould not be vain and illusory. (Vattel—Chapter 17, section 283)."[9]

10.5.5 Tested in the light of this principle, we are unable to accept the argument of Madhya Pradesh and Maharashtra that in executing clause 4 of the agreement (Ex. C-1) dated 12th July 1974, the four party States intended that the Rajasthan areas were all to be irrigated with 0.5 MAF of Narmada water by "the grossly uneconomical method" of lift irrigation.

10.6.1 On 28th July, 1975, the Tribunal gave directions to the State of Rajasthan for filing a modified Project Report for the utilisation of 0.5 MAF of Narmada waters. Rajasthan filed the project Report (Exhibit R-267) with CMP 59/1976 on 11-2-1976. According to this Project Report, the Navagam Canal was assumed to take off

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[6] (1809) Edwards 128, 131.

[7] Moore—Historical Digest of International Arbitrations pp. 1564-1565.

[8] Voici une 3me, Maxime generale, ou un 3me. Principe, au Sujet de l'interpretation : ni l'un ni l'autre des interesses, ou des Contractans n'est en droit d'interpreter a son gre l'Acte, ou le Traite. Car si vous etes le maitre de donner a ma promesse le sens qui vous plaira, vous ferez le maitre de m'obliger a ce que vous voudrez, contre mon intention, & audela de mes veritables engagements : Et reciproquement, s'il m'est permis d'expliquer a'mon gre' mes promesses, je pourrai les rendre vaines & illusoires, en leur donnant un sens tout different de celui qu'elles vous ont presente, & dans lequel vous avez du les prendre, en les acceptant. (Vattel—Droit de gens—Book II, Chapter XVII, sec. 265—Carnegie Edn).

[9] On ne presume point que des personnes sensees ayent pretendu ne rein faire en traitant ensemble, ou en faisant tout autre acte serieux. L'interpretation qui rendroit un Acte nul & Sans effect, ne peut done etre admise. On peut regarder cette Regle comme une branche de la precedente: car c'ost une espece d' absurdite, que les termes memes d'un Acte le reduisent a ne nien dire. Il faut l'interpreter de maniere, qu'il puisse avoir son effect, qu'il ne se trouve pas vain & illusoire. (Vattel—Droit de gens—Book II Chapter XVII Section 283— Carnegie Edition).

at Sardar Sarovar with FSL as +300 (same as proposed by Gujarat), but with a bed gradient of 1 in 12,000 from head to the boundary of Rajasthan, where the water level attained would be RL 141. The bed gradient of the canal in Rajasthan will also continue to be 1 in 12,000.

10.6.2 Rajasthan proposed that the Manning's coefficient of rugosity "N" for the canal should be adopted as 0.015, as against 0.018 proposed by Gujarat. This would mean higher velocity of flow and reduce cost of the canal.

10.6.3 In this Project Report of Rajasthan, small areas near the canal in Rajasthan are likely to be irrigated by the cultivators by lifts of about 2 metres.

Alternative Low-Level Canal Scheme From the Navagam Low Dam, submitted by Maharashtra State

10.7.1 Even before the project for utilisation of 0.5 million acre feet of water by Rajasthan was submitted (Exhibit R-267), on 11 the February, 1976, Maharashtra had submitted an alternative low level canal scheme from the low Sardar Sarovar dam (Exhibit MR-102), submitted with CMP 193/75, dated 31-7-1975. The 'basic scheme' in this report is the Navagam canal wi h FSL of 190 ft., with a flatter bed gradient of 1 in 20,000 upto the off take of the Banni Branch ; 1 in 10,000 therefrom upto the offtake of the Madka (Khadol) branch ; and 1 in 6,000 thereafter to the tail of the main canal. The water requirements for this canal was taken as 17.37 MAF. Allowing for calculated head losses at the Cross Drainage Works, bridges and other structures, the overall bed gradient is of the order of 1 in 12,777. These bed gradients are considered by Maharashtra to be not only theoretically sound but are supported by case studies of a number of canals in practice.

10.7.2 In addition to the basic scheme, studies were given for the following three alternatives :—

Alternative I-A envisages irrigation in the entire areas as in the basic scheme, but excludes the Banni Areas, Great Rann (North) and Zone XI-A, B and C, and includes on lift-command the area between the FSL 250 canal and the FSL 190 canal upto Sabarmati river and the area between FSL 300 and FSL 190 canals beyond the Sabarmati River—Potential Annual Water Requirement 13.56 MAF.

Alternative I-B envisages the same command as in Alternative I-A, except that it excludes the lift areas between the FSL 190 canal and the FSL 250 canal upto Sabarmati River, but includes the Banni areas and Zone XI-C on lift command—Potential Annual Water Requirement 13.94 MAF.

Alternative II envisages the irrigation in the entire areas of Zones I to X, the Mahi command, and the Little Rann command, under flow, and the area between the FSL 300 canal and the FSL 90 canal beyond Sabarmati river by lift—Potential Annual Water Requirement 11.05 MAF.

These alternative schemes were proposed with a view to examining the scope of the command of low level canal by flow and lift irrigation corresponding to different water requirements of the Sardar Sarovar Project. Maharashtra relied on certain formulae, particularly the Lacey's formula, which are said to give a proper design for unlined channels flowing in their own alluvium and transporting minimum sediment load. Maharashtra suggested exclusion of certain portion of the sediment load by means of silt excluders and silt ejectors. It stated that a lined canal designed with Manning's formula had a greater sediment transport capacity than an unlined canal with the same slope. It further stated that a slope of 1 in 20,000 for a lined canal carrying less than 3,000 cusecs was entirely adequate, specially if it takes off direc.ly from a large s'orage reservoir as in that case it would not have even the minimum sediment charge, which would be transported according to Lacey's formula.

Maharashtra stated that when a canal takes off from a reservoir which acted as a sediment excluder with 100 per cent efficiency, the canal would have to carry only wash load, and that since the particle sizes of wash load pertaining to clay were sufficiently fine, i.e., of the order of 0.006 mm, the fall velocities would be very small, and that the smallest turbulance would keep this material indefinitely in suspension.

In para 2.2 of Chapter II of MR-102, Maharashtra gave a statement of the bed slopes of lined canals in India, wherein the flattest bed slope given is 1 in 10,000 for any lined canal, and out of these, Tungbhadra Left Bank Canal and Nagarjunasagar Left Bank Canal, which off-take from a high dam, are given 1 in 10,000. It is mentioned that the bed slope of 1 in 12,000 for the Nagarjunasagar Right Bank Canal for a capacity of 11,000 cusecs has been provided. The discharge and the bed slopes of some unlined canals are also mentioned in this Chapter.

10.7.3 Maharashtra has made other assumptions of which the important ones are as follows :—

(1) In view of considerable storage available in the low Sardar Sarovar Dam also the water entering the canal from FSL 190 would be clear water ;

(2) The weighted mean diameter of the silt entering the canal is worked out as 0.075 mm;

(3) The slope of the canal adopted by Maharashtra satisfies the requirements of the non-silting velocity for unlined canal, and, therefore, should be satisfactory for a lined canal ;

(4) Tractive force available in the proposed design of the lined canal would be adequate to keep the silt in movement and carry it out of the canal to the fields ;

(5) The Lacey's silt factor would be 0.5 for the grade of suspended silt considered ; and

(6) the modified critical velocity formula of $Vc=0.84\ D^{0.5}$ as applicable to clear water, would be applicable to the proposed Navagam Canal.

10.7.4 In Chapter III of MR-102, the alignment of low-level Narmada canal with bed gradient of 1 in 20,000, has been discussed.

10.7.5 In Chapter IV of MR-102, the gross commanded area (GCA), the culturable commanded area (CCA), the annual irrigation, the cropping pattern, the water requirement at the field, and the designs of the optimum low-level Narmada canal basic schemes, have been dealt with.

10.7.6 Maharashtra argued that it would be possible for Gujarat to select enough areas to be served by flow irrigation from the command of 190 canal to use all the water which was likely to be allotted to it under any scheme of equitable distribution and that lift irrigation would not be needed. If, however, Gujarat elected to irriagate some areas above the command of the 190 canal by lift, it might do so on its own and that the cost of such lift irrigation should not be considered as a charge on the low-level canal scheme.

Main Objections of Gujarat and Rajasthan to the Proposal of Maharashtra

10.8.1 *Objections of Gujarat* : Gujarat has contested the proposal of Maharashtra, vide Exhibit G-835. Gujarat has stated that the proposal is not adequately investigated, nor is it technically sound, and that the examples of canals given by Maharashtra do not support its contention. The main objections are as follows :—

(1) The alignment of the proposed canal with a bed-gradient of 1 in 20,000, and the studies based thereon, are paper studies and no detailed investigations have been made for crossing of the existing en route rivers and for other important features.

(2) The lined canals are not designed on the basis of non-silting velocity, but on the maximum permissible velocity.

(3) The proposed alignment passes flood zones of the rivers crossed en route, and hence the possibility of breaches with canal running in heavy embankment in such zones would involve public hazard and may result in disastrous effect on the irrigation system.

(4) Considerable areas of CCA of better classes are perpetually relegated to lift irrigation and predominantly drought affected areas, having necessity for irrigation, are left out by the 190 canal.

(5) Irrespective of any actual allocation, Gujarat cannot deny irrigation to the better class of areas above the command of the 190 canal and the available water has to be spread to as large an area as possible so that the maximum number of persons are benefited. Hence, provision of lift irrigation to such areas above the command of the 190 canal cannot be avoided.

(6) The alignment in the head reach of the canal, as proposed along the river bank, would not be safe.

(7) The larger cross section of the canal necessary on account of the flatter bed-slope for the proposed canal, would be more expensive for excavation, lining and structures on the canal.

(8) The canal alignment at Ahmedabad would pass through congested areas, which is not feasible, and it will make the embankment higher, whereas the land for the alignment of 300 canal north of Ahmedabad has been already acquired.

(9) Maharashtra's proposed is for a dam at the site No. 1, whereas Gujarat's proposal is for a dam at site No. 3.

(10) The assumption of Maharashtra that the waters entering the Navagam canal would be relatively silt-free, is not correct.

(11) For the design of lined irrigation canals, it is the size of the active bed material which has to be considered, and not the observed suspended sediment.

(12) The Dam at Navagam with FRL 210 and canal sill level of RL 170 would get silted in about 50 years.

(13) The assumption of Maharashtra that 0.5 MAF water to be allocated to Rajasthan can be exchanged with Gujarat for an equivalent supply from Mahi-Kadana system, is not practicable.

Objections of Rajasthan

10.8.2 Rajasthan has objected to the proposal of Maharashtra mainly on the following grounds, (see Written Submission 7A) :—

(1) Rajasthan will be forced to adopt lift irrigation for the whole of its areas ;

(2) A canal with a flat gradient proposed by Maharashtra is not technically feasible ;

(3) The silt factor adopted should not be based on data of suspended silt, but should be based on data of shoal material found in Narmada River bed, which would give the value of Lacey's "f" as 1.43 ;

(4) The canal takes off at a diversion structure and the theory of clear water does not apply ;

(5) Mahi river has no surplus water and there is no question of any exchange with Narmada water to be given through the high level canal ;

(6) Maharashtra itself has admitted that irrigating Rajasthan areas from the 190 canal would not be justifiable on techno-economic considerations ;

(7) The decision of the Tribunal dated 8-10-1974 was to the effect that Rajasthan is entitled to an allocation of 0.5 MAF of Narmada waters through a direct canal from Sardar Sarovar dam.

(8) Maharashtra has throughout been interested in the development of power. Maharashtra is not interested in irrigation for lack of suitable areas in that State and its attempt is to get the largest share of power at the cost of irrigation to other party States.

10.9.1 We shall now proceed to examine the question of FSL of Navagam Canal on the following parameters :—

(i) The quantum of Narmada water allotted to Gujarat State, including the water required for domestic and industrial uses, after allowing for water available from en route rivers, is 9 MAF delivered at the head of the Navagam canal.

(ii) The CCA to be irrigated in Gujarat will be limited only to that indicated in Zones I to XI and shall not include the areas in Mahi command, Banni and the Ranns of Kutch.

(iii) The pattern of releases of water into the canal, month-wise, will be proportional to the needs of the Zones indicated by Gujarat in Exhibit G-960.

(iv) The benefit of irrigation has to be given to as large an area as possible, particularly in areas with low and erratic rainfall. Hence, areas commanded between 190 and 300 canals should not be left out from the scope of the project and if lift irrigation is necessary, the question of cost must be taken into consideration.

(v) Bed gradient for the canal :

The proposals are as follows :—

(1) by Gujarat i.e., a bed gradient of 1 in 10,000 from the head of the +300 Navagam canal to the offtake of the Banni branch at mile 262, and 1 in 6,000 thereafter.

(2) by Maharashtra, i.e., a bed gradient of 1 in 20,000 from the head of the +190 Navagam canal to the offtake of the Banni branch, 1 in 10,000 therefrom upto the offtake of the Madka (Khadol) branch, and 1 in 6,000 thereafter to the tail of the main canal.

(3) by Rajasthan, i.e., a bed gradient of 1 in 12,000 from the head of the Navagam Canal to the tail of the +300 main canal.

Preferential Use and Equitable Appointment

10.10.1 At the outset the important question for consideration is the conflict between providing flow irrigation to a reasonable extent for areas in Gujarat and Rajasthan and the generation of power by curtailing the extent of such irrigation by flow.

As a matter of law there is no fixed or automatic preference of one use over another (Article VI, Helsinki Rules). But one use may be preferred to another use in the circumstances of a particular case because of its greater value and importance to the community as a whole. As Pierre Sevette[9(1)] has observed :—

> "The question arises whether these various uses can be classified according to their economic importance and an order of priority established*** When a conflict arises in international law, as of course in other branches of law, between opposing interests (even though they are legitimate when taken singly), it is necessary to assess these interests, classifying them in order of importance and deciding which of them should come first."

As stated by H. A. Smith[9(2)] :—

> "The Chief practical function of law consists in regulating the conflicts of different interests In order to do this it must make some attempt to appraise and rank them in order of value, laying down that in a given situation one interest is to be preferred over another."

The preference of one use to another differs from basin to basin and from one part of a basin to another, and it may even vary within the same basin or sub-basin as conditions change and the relative importance of the use develops with time.[9(3)]
Economic, social engineering and resource studies supply the basis for determining the priorities appropriate to the needs and possibilities of each basin.[9(4)] Each river has its unique problem which must be examined and determined separately.[9(5)]

9(1) Legal Aspects of the Hydro-electric Development of Rivers & Lakes of Common Interest, UN Doc. E/ECE/136/EP/98 Rev. I, pp. 26-27.

9(2) H.A. Smith, The Economic Uses of International Rivers, 1931, p. 130.

9(3) R.E. Clark, Water & Water Rights (1967) Vol. II, p. 425, Legal Aspects of the Hydro-Electric Development of Rivers & Lakes of Common Interest, UN Doc. E/ECE/136, E/ECE/HP/98 Rev. 1(1952), pp. 26-37: R.C. Martin & Others, River Basin Administration & the Delaware (1960), p. 275.

9(4) J.D. Chapman, The International River Basin (1963), p. 16. Historical, geographical and political considerations should also be borne in mind. Legal Aspects of the Hydro-electric Development of Rivers & Lakes of Common Interest. UN Doc. E/ECE/136, E/ECE/EP/98, Rev. 1 (1952), p. 36; R.E. Clark, Water & Water Rights (1967) Vol. II, p. 425; UN Memorandum of 1950 cited in F.J. Berber, Rivers in International Law (1959), p. 159.

9(5) A.H. Garretson & Others, The Law of International Drainage Basins (1967), pp. 61, 787.

There is no legislation in India laying down any order of priority for different uses. In the absence of such legislation, the order of priority of different uses is merely one aspect of the doctrine of equitable apportionment and determined by the Tribunal on that basis.

> "Thus it may be either natural barriers of the fact that a use is economically and socially more valuable than other uses may lead to the preference of one use over another. However, it is not necessary to embody these factors in a separate category since the consideration of all relevant factors affecting the uses of a river is basic to the determination of equitable utilization. Thus, all factors that would be considered in the designation of a preferential use are considered in the process of deciding whether a use is consistent with the equitable utilization of the basin. (Olmstead, Law of International Drainage Basin, p. 62).

Clyde Eagleton reiterates the same legal position[9(6)]:—

> "In a number of cases and treaties something is said concerning certain uses of the water to be regarded as more important than other uses, and consequently to be given priority of rights. The establishment of such priorities in each situation belongs, I think, to equitable apportionment."

Conflict between Irrigation by Flow and Generation of Power by curtailment of Irrigation of Flow

10.10.2 As we have already stated, the important question for consideration is the conflict between providing flow irrigation to a reasonable extent for areas in Gujarat and Rajasthan and generation of power by curtailing the extent of such irrigation by flow. In this connection, it is relevant to quote para 5.21 and 5.22 of the Report of the Irrigation Commission, Volume I, page 90.[10]

> "5.21 Multipurpose river valley projects offer the best use of surface water resources; but apart from situations where both power generation and irrigation may be possible, there may be other cases in which a choice has to be made between the use of water either for irrigation or power generation. The Western Ghats offer sites with high heads for the generation of cheap hydro-electric power by diverting westwards the waters of east-flowing streams. In Maharashtra, parts of the waters of the Koyna, a tributary of the Krishna, has already been partly diverted westwards to generate hydro-electric power at Koyna power station, which has an installed capacity of 560 MW. In such cases, where a choice is involved, the priority has to be determined not only by economic considerations, but by recognition of the fact that irrigation is possible only by the use of water, whereas power can be generated from alternative sources such as coal, gas, oil and atomic fuels.
>
> 5.22 In view of the overall scarcity of water resources, we recommend that wherever a choice has to be made between irrigation and power generation, preference should be given to irrigation. The east-flowing rivers rising in the Western Ghats traverse areas which have low rainfall and suffer from water scarcity. The needs of these areas should receive priority. It is interesting to note that the United States Bureau of Reclamation considers irrigation of paramount importance in the planning of multi-purpose projects, and nowhere in its policy-making legislation does the Bureau accord recognition to power production as a function superior to the use of water for irrigation."

10.10.3 For irrigation use, there is obviously no substitute for water, but power may be generated from coal, oil nuclear energy and other sources. In general, whenever production of hydro-electric power interferes with irrigation and the two uses cannot be reconciled, increasing priority may have to be given to irrigation. Rapid growth in population calls for increased food production which in turn calls for intensified irrigation.[11]

10.10.4 In countries with a hot and arid climate, water is absolutely indispensable for cultivation of the soil, and the use of water for irrigation is regarded as an ordinary or primary use for satisfying a natural want. In the arid and semi-arid parts of the country, irrigation makes the difference between waste land and highly productive crop land.[12] J. Guthrie Brown observed[13]:

> "Finally it may be said that in arid areas the use of water for irriagtion will, where soil conditions are suitable, take precedence over its use for power production."

10.10.5 In India, with the rapid growth of population, the demand for additional food supplies and raw materials is increasing. For survival, the nation must have more food and more raw materials. The supplies and prices of agricultural commodities, particularly of food, play a crucial role in attaining economic and social stability. Indian economy is predominanetly agrarian, as 75 per cent of th ecountry's population depends on agriculture for livelihood. Nearly 60 per cent of total household consumption and 85 per

9(6) Clyde Eagleton, The Use of Waters of International Rivers, 33 Canadian Bar Review Vol. 33 (1965) pp. 1018, 1025.

[10] Report of the Irrigation Commission Vol. I, p. 90.

[11] E. Kuiper, Water Resources Development, Planning Engineering & Economics (1965), pp. 13, 15.

[12] The Nations Water Resources, U.S. Water Resources Council p. 4-4-1.

[13] J. Guthrie Brown : Hydro-electric Engineering Practice (1958) Reprinted (1963), p. 155. See also Otis W. Freeman H.F. Raup, Essentials of Geography 2nd Edn., pp. 390—391.

cent of the commodity consumption of households are composed of agricultural products or manufacturers based principally on agricultural raw materials.[14] A strong agricultural base is essential for industrial development. Agro-based industries like textiles, starch products, sugar and oil pressing can be fed only by agriculture. For food, the basic requirement of life, the nation cannot afford to depend on imports. Development of agriculture calls for irrigation on a large scale. The use of water resources for irrigation to the fullest extent possible is an essential condition for diversifying agriculture and increasing crop yields. Thus, irrigation plays a key role in the planned development of the country.[15] Without irrigation, large arid tracts of the country would be permanently waste,[16] while many other tracts having low and uncertain rainfall could be cultivated only in favourable seasons. In view of the pressing necessity for irrigation, India has more irrigated land than any other country in the world.[17]

10.10.6 We are accordingly of opinion that irrigation use of waters of Narmada should prevail over its hydro-electric use in case of any conflict of the two uses in the circumstances of the present case.

10.10.7 In this context, it is necessary to emphasize that the power required for lifting water to a particular height for providing lift irrigation is substantially more than that which can be generated by the same quantity of water with that height. The power, P, which a discharge Q cusecs generates with a head H feet, $P = \frac{QH}{14}$. The power P R which is required to lift Q cusecs to a head of H feet, however, is $\frac{QH}{10}$. Therefore, the ratio of $\frac{PR}{P}$ is $\frac{14}{10}$ or 1.4. In other words, 40 per cent more power is required to lift water to a given height than can be generated by the same quantity of water dropped through the same height. Again, power generated at the dam would need to be transmitted to the pumping stations and there would be transmission losses. When this is taken into consideration, the ratio becomes even higher than 1.4.

10.10.8 The information available for estimated capital cost for providing pumping installations for a few lift irrigation schemes is given below :—

Sl. No.	Name of Scheme	Cost of installation with connected civil works (Rs. lakhs)	Annual irrigation in acres	Max. lift in ft.	Capital cost of installation of lifting equipment per acre of irrigation	Remarks
1.	Sewani lift irrigation scheme (Haryana)	75.65	89,962	96	84.1	Project Report (May, 1971)
2.	Rajasthan Canal Project (Stage II)	2898.00	10,56,913	263	274.2	R-269 (Project Report prepared by WAPCOS).
3.	Loharu lift irrigation scheme (Haryana)	345.8	1,85,700	214	186.2	
4.	Jui lift irrigation scheme (Haryana).	53.03*	46,207	129	114* 187**	*Cost of pumps only. **Cost of pump houses @ Rs. 73/-per acre, as in Loharu Scheme added).

NOTE :—The cost of installation is only for pumps and pump houses, and does not include the cost of power transmission lines or the water distribution system.

10.10.9 In the Sewani Lift Irrigation Scheme of Haryana, the additional cost of lifting water to a maximum lift of about 90 feet has been worked out as Rs. 228 per acre even with low rate of energy of Rs. 0.11 per Kwh. The water rate chargeable for irrigation of wheat by flow, as indicated in the Sewani Project Report, is Rs. 5.80 per acre. The water rate levied on the Rajasthan canal for flow irrigation of wheat at present is Rs. 20 per acre, while the additional cost of lift irrigation has been worked out at about Rs. 183 per acre for a maximum lift of 263 feet, as indicated in Rajasthan Canal Project (Stage II) prepared by WAPCOS, vide Exhibit R-290. In the project for irrigating five blocks of area by lift irrigation, the cost of power alone for irrigating areas by lift for 30 metres is estimated as Rs. 130 per hectare of area irrigated. In addition to this, there will be the capital cost of providing plant and equipment for lifting water. This shows that the irrigation by lift is expensive and, as such, it may be provided only for those areas where there is no means of irrigation by flow or shallow wells and irrigation is essential for sustaining the population of such areas.

14 Fourth Five Year Plan, pp. 12, 13, 28, 35, 38.

15 Water Resources Series No. 38 U.N. ECAFE, p. 132.

16 Development of Irrigation in India 1965, Publication No. 78, Central Board of Irrigation and Power, p. 5.
See otis W. Freeman, H.F. Raup, Essentials of Geography 2nd Edn., p. 390.

10.10.10 As per proposal of Gujarat for 300 canal and that of Maharashtra for 190 canal (MR-102), the CCA proposed to be irrigated by flow and lift in the different zones are as follows :—

(lakh acres)

Proposed	Total area	By flow	By lift
+300 canal as proposed by Gujarat	54.02	49.40	4.62
+190 canal as proposed by Maharashtra . . .	42.97	32.27	10.70
Difference	11.05	17.13	6.08

It will be noticed that the difference of 11.05 lakh acres in the total area in the two proposals can be made up only by providing lift irrigation in 11.05 lakh acres between 300 level canal and 190 level canal. Maharashtra's proposal for 190 level canal envisages lift irrigation in 10.70 lakh acres in Saurashtra branch and Kutch areas, against 4.62 lakh acres in these areas in the Gujarat's proposal for 300 level canal. Thus, if the total area of 54.02 lakh acres proposed by Gujarat is to be served by Maharashtra's proposed 190 level canal, then an area of 17.13 lakh acres (11.05+6.08) will need to be served by lift in addition to what would be served by lift by the +300 level canal. For an allocation of 9.00 MAF to Gujarat the extra cost of lifting water from 190 canal for irrigating area in the command between 190 canal and 300 canal is about Rs. 17 crores as roughly estimated in Annexure X-1.

10.10.11 In addition to this, there will be an additional expenditure on the increased lift in Saurashtra and Kutch area of Rs. 2.65 crores per year, and on Rajasthan's requirements, amounting to Rs. 3.28 crores per year, as given in Annexure X-1.

Provision of Silt Excluders and Ejectors for Navagam Canal

10.11.1 Maharashtra has contended that if silt excluders or silt ejectors are provided for the canal with a bed gradient of 1 in 20,000, it would keep the canal free from silting, and that such devices have been used in several irrigation canals.

Sediment Excluders

Maharashtra at page 6 of its Note 21 has quoted from CBIP Publication 79, as below :—

> "It appears, while the efficiency of the excluders is very high to start with, the excluders are not free from trouble, and with the particular exception of the Western Yamuna Canal Tajewala sediment excluder, their long-term sediment exclusion effect is not positively established."

It has further stated that

> "More than one sediment excluding devices are required. The decantation at several sites is necessary."

Sediment Extractors
(Or Ejectors)

As regards silt extractors or ejectors, Maharashtra at pages 10, 11 and 12 of its Note 21, has quoted the C.B.I. & P Publication, as below :—

> "A series of extractors may be required for a canal system, as one extractor, however, efficient in design, may not be able to deal with the whole of the sediment load in the canal."

It has further quoted,

> "Such extractors require 20 to 25 per cent of the canal discharge as escape discharge for ejection of the coarser sediment load and a head of 2 to 4 ft. for flushing."

10.11.2 From the examples of extractors given by Maharashtra in its Note 21, it is evident that the efficiency of the extractors is generally 40 to 60 per cent. The use of excluders or ejectors, therefore, cannot ensure complete exclusion of medium grade of sediment from Navagam canal, even though the coarse silt may settle in Sardar Sarovar and the ponds at the head of the canal. Excluders and ejectors can, therefore, be used only as a limited corrective measure. As these devices entail use of water, the question to be considered would be as to how much of the precious water can be escaped for extracting the medium sediment from Navagam canal, as the water so escaped will go waste to sea. No water is proposed to be let down from Sardar Sarovar to the sea in a year of 75 per cent dependability.

10.11.3 On silt entering Navagam canal, the only remedial measure practicable would be to silt clear the canal which would require its closure and affect irrigation. In view of the importance of Navagam canal and the large areas it would irrigate, such a closure is not considered desirable or even practicable, especially if a large quantity of sediment enters the canal.

Effect of Sediment Load on the Design of Bed Gradient of Navagam Canal

10.12.1 The important question is the determination of a suitable bed-gradient of the lined Navagam canal, taking into consideration the sediment which is likely to be transported by it without getting silted up.

10.12.2 Statement 1 of Annexure X-2 shows the observed sediment of river Narmada at Garudeshwar gauging station, giving quantity and percentages of coarse, medium and fine silt for the years 1962 to 1976. A similar statement for Mortakka gauging station for the years 1951 to 1952, 1956 to 1959 and 1962, is attached as Statement 2 of Annexure X-2. Assuming that the fine silt would be carried by the flattest of the bed gradient proposed by the party States and that the coarse grade of silt would most probably not enter the canal on account of the depth of water in the reservoir, especially during the initial period, it is reasonable to hold that the size of medium sediment

should be the controlling factor for the sediment transportation capacity of this canal. Referring to Column 10 of Statement 1 in Annexure X-2 mentioned above, the percentage of the medium sediment observed during the various years ranges from 1.83 per cent to 89.82 per cent of the sediment load in the Narmada river at Garudeshwar. Such high variation is difficult to explain. Even on ignoring the two highest percentages of 85.67 in the year 1974, and 89.82 per cent in the year 1975, the variation ranges from 1.83 per cent to 55.87 per cent. The average of these remaining ones comes to 14.49 per cent. If the observation of the two years 1974 and 1975 are also included, the average comes to 22.28 per cent. These are shown at the bottom of Statement 1 in Annexure X-2.

10.12.3 From Statements 1 and 2 in Annexure X-2, it is apparent that the quantity of medium sediment is quite substantial. Therefore, it has to be ensured that even a portion of this sediment does not start settling on the bed of the canal and gradually silt up the canal.

10.12.4 Maharashtra has suggested that for determining the bed-gradient of a lined canal, the weighted mean diameter of the silt should be the criterion. This assumption needs closer examination. It may be noted that no observations have been made of the active bed sediment of the river at Garudeshwar. Therefore, Maharashtra has used data of suspended sediment. Rajasthan has suggested that for the purpose of proper design of the canal, the size of the silt should be worked out from the material of the shoals in the river bed about 3 to 18 miles downstream of the site of the Sardar Sarovar dam, for which data are available in Exhibit G-251-A. The existence of the shoals indicates that heavier grade of silt was being transported during certain stages of river flow and it should not be ignored.

10.12.5 Another aspect to be examined is the silt charge which is likely to be drawn into the canal on silting up of Jalsindhi and Sardar Sarovar reservoirs upto penstock/outlet levels. A note indicating the period in which the siltation is likely to take place. is attached as Annexure X-3. The calculations made in the note are based on the empirical formula (area increment formula) suggested by M/s. Borland & Miller Paper No. 3019—Transaction ASCE 1960 Distribution of Sediment in Large Reservoirs by Borland & Miller. According to this formula, it would take about 100 years for the river reach between Maheshwar and Jalsindhi dams to silt upto the level of penstocks and much earlier upto outlet levels if these are provided at a lower level. The process of siltation between Jalsindhi and low Sardar Sarovar dams would start from the very beginning due to sediment load brought in from the catchment between Jalsindhi and Navagam dams through a large number of small streams with steep gradients. Another important factor which would lead to rapid siltation would be the density currents. These density currents will carry greater intensity of sediment, and in consequence larger volume from an upper reservoir to a lower reservoir and further into the canal. Trap efficiency of any reservoir is not 100 per cent in practice, though theoretical study may indicate full effectiveness. Therefore, the possibility of medium silt entering the Navagam Canal cannot be ruled out.

10.12.6 Kennedy's and Lacey's theory, on which most of the unlined canals in India have been designed, were based on observations and analysis of data for unlined channels which were non-silting and non-scouring. These theories make use of mean diameter of silt. While unlined canals designed on the basis of mean diameter of silt may function satisfactorily, the same is not necessarily true of lined canals.

10.12.7 Lacey has suggested the following formula for bed slope, depending on the silt factor, as stated in para 1.1 of Exhibit MR-102 :—

$$S = \frac{(f)^{5/3}}{1830 \times (Q)^{1/6}}$$

where S = Longitudinal bed or water surface slope

f = Lacey's silt factor $= 1.76\sqrt{D(bm)}$

D(bm) = diameter of bed sediment material in mil'i-metres.

G = Discchargc or capacity of canal section to be designed (in cusecs)

10.12.8 It should be emphasised that Lacey's formula has not been advocated or adopted for design of lined channels. Maharashtra has designed the canal on the basis of Lacey's theory for an unlined canal and considers that the bed slope derived from this theory should be satisfactory even for a lined canal. This inference or extrapolation cannot be justified as no such precedent for use of the formula for lined canal is known. In applying an empirical formula for new conditions, extreme caution is necessary, as its limitations may not be fully realised. Maharashtra has conceded that there is no known specific formula for non-silting velocity for a lined canal (Exhibit MR-102, page 6).

Even if Lacey's formula is applied for determining the slope of the Navagam lined canal, it would be prudent to consider the maximum size of the silt to be transported. Utilising this formula, therefore, for the maximum size of the medium silt, that is, 0.152 mm, Lacey's 'f' works out to 0.686. The discharge during the month of August would be the controlling discharge as during this month, heavy charge of sediment is to be expected due to floods. For an allocation of 9 MAF to Gujarat and 0.5 MAF to Rajasthan, the discharge in August is of the order of 9280 cusecs at the head of the canal. For this discharge, the flattest bed gradient in the head reach works out to 1 in 15,700 which is considerably steeper than 1 in 20,000 proposed by Maharashtra for the 190 canal.

10.12.9 One of the formulae used by Maharashtra to check the slope proposed by it, is based on the critical bed shear or tractive force theory (according to values set out by Streeter—Maharashtra Note 9). However, in Exhibit MR-131, page 48, it states that—"the tractive force formulae are applicable only to unlined canals.....". This formula based on tractive force theory has not yet been accepted in India for designing lined canals.

10.12.10 In support of the bed gradient proposed by Maharashtra, Madhya Pradesh filed a study in

November, 1977, by Dr. P. Natarajan of the Indian Institute of Technology, Delhi, and Dr. Kanwar Sain, Ex-Chairman, Central Water & Power Commission, vide Exhibit MP-1173. This study does no more than seek to establish that with the silt size assumed in Maharashtra's design in MR-102, the canal is not expected to silt up. It does not meet the objection of Gujarat and Rajasthan that the silt particles that will enter into the canal will be larger than assumed. Nor does it by itself provide a basis for designing the canal.

10.12.11 The bed gradients adopted in some of the important lined canals constructed in India, are given in Annexure X-4. Out of these, the following lined canals take off from reservoirs and their bed gradients are indicated against each :—

Sl. No.	Name of the canal	Discharge (Cusecs)	Bed Gradient
1.	Sundarnagar Hydel Channel (Beas Project) . . .	9,000	1 in 6,666
2.	Tungabhadra Left Canal .	7,000	1 in 10,000
3.	Tungabhadra Low Level Canal	1,323	1 in 10,000
4.	Nagarjunasagar Right Bank Canal	11,000	1 in 12,000
5.	Nagarjunasagar Left Bank Canal	15,000	1 in 10,000

It is to be noticed that in none of the canals cited above the gradient is flatter than 12,000. The Nagarjunasagar right bank canal takes off from a reservoir where the depth is of the order of 250 ft. Ninety kilometers upstream of Nagarjunasagar dam, another dam, Srisailam, is being constructed which will trap a great deal of silt brought in by the river. In spite of these two deep reservoirs, the Nagarjunasagar right bank canal has not been constructed with a gradient flatter than 1 in 12,000.

10.12.12 Maharashtra has, in Exhibit MR-102, proposed the + 190 canal with a gradient of 1 in 20,000. The canal, according to Maharashtra, can take off either from Navagam Site 1 or Site 3. In Chapter XI, we have determined that Sardar Sarovar dam has necessarily to be at Site 3 on account of the height of the dam. Maharashtra's proposal for +190 canal has the following deficiencies :—

(1) It reaches Rajasthan at about +63.10 requiring most of the area to be served by lift, whereas the agreement between the States implies most of the irrigation by flow.

(2) A large area of Gujarat would be served by lift.

(3) Offtake from Site 3 would pose some hazard in the head reach of the canal.

(4) It has not been convincingly established that Navagam Canal with a flat gradient of 1 in 20,000 would function satisfactorily without the risk of siltation.

(5) No lined canal in India has so far been constructed with such a flat gradient.

Considering all these factors, in our opinion, the +190 canal with a flat gradient of 1 in 20,000 should be rejected.

Proposed Bed Gradient for the Navagam Canal

10.13.1 Gujarat has proposed a bed gradient of 1 in 10,000 for the +300 canal with a view to allowing maximum permissible velocity and, thus, effect economy in the section of the canal and cost of lining. Rajasthan has suggested a gradient of 1 in 12,000 to command most of its areas by flow. We notice that upto the offtake of Saurashtra branch at mile 180, there is adequate discharge to permit a gradient of 1 in 12,000 being adopted. However, beyond the offtake of Saurashtra branch, due to reduction of the discharge, the gradient would need to be steeper and in our view a gradient of 1 in 10,000 would be suitable upto the Gujarat-Rajasthan border at mile 310. This canal would reach the border at an elevation of about 131 instead of 99.47 proposed by Gujarat and 141.31 proposed by Rajasthan.

10.13.2 Rajasthan has proposed that water would be used by it in the Rabi season. Even if a small amount of silt settles in the tail portion of the canal with a slope of 1 in 10,000, it would be possible to silt clear that portion of the canal without much trouble or cost during the hot weather season when the canal could be conveniently closed in the lower reaches.

10.13.3 The proposed canal with a bed gradient of 1 in 12,000 upto the offtake of Saurashtra branch, and 1 in 10,000 beyond, would command somewhat higher areas in Gujarat than a canal with a bed gradient of 1 in 10,000. Gujarat has put forward the plea that higher areas in Gujarat are better suited for irrigation. The flatter gradient of the canal would also enable some additional area to be brought under command. Annexure X-5 gives the area which would be served by flow and lift under different proposals.

Conclusion

10.14.1 In view of these considerations, our conclusion is that the FSL of the Navagam Canal should be fixed at FSL +300 at its head regulator with a bed gradient of 1 in 12,000 upto the offtake of Saurashtra branch at mile 180 and 1 in 10,000 thereafter upto the Gujarat-Rajasthan border for reasons given in paragraphs 10.13.1 to 10.13.3. This would reach the border at about RL 131.

10.15.1 The question of the FSL of Navagam Canal is the subject matter of Issue No. 13(b) which reads :—

"Should any directions be given

(a) . . . . . .

(b) for specifications of FRL and MWL of the storage at Navagam Dam and the FSL of Navagam Canal so as not to prejudicially affect the interests of Madhya Pradesh, Maharashtra or the other concerned States ?"

Our answer to this issue is that the Full Supply Level of Navagam Canal should be fixed at +300 at its head regulator. We have also decided the bed gradients of this canal for the various reaches in paragraph 10.14.1. We, however, desire to make it clear that the bed gradients fixed in paragraph 10.14.1 may be changed by Gujarat and Rajasthan by mutual agreement, if they so choose.

Advice of the Assessors

10.15.1 We have consulted our technical Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Ajyar, with regard to the subject matter of this chapter. They have advised us that they all agree with the conclusion reached in paragraph 10.14.1 and also the reasoning given by us in the previous paragraphs.

ANNEXURE X-1

Extra Annual Cost of Lift Irrigation

(a) Extra Annual Cost of Lift Between 300 And +190 Canals

According to Maharashtra proposal 17.13 lakh acres served by flow from 300 canal would need to be served by lift.

Area = 17.13 lakh acres

Lift involved = 110 ft. (300—190) = 33 metres.

Water requirements for 17.13 lakh acres

(assuming 9.0 MAF for 54.02 lakh acres)

$$= \frac{9 \times 17.13}{54.02} = 2.85 \text{ MAF}.$$

According to the Rajasthan Canal Project (Stage II) Report prepared by WAPCOS—the annual cost of energy for lifting water for 1 hectare (water quantity of 0.51 hectare metres) vide R-290, Vol. I, Annexure 3-1(4) is :

for lift of 40 metres	= Rs. 172.4
for lift of 30 metres	= Rs. 129.3
Therefore, for 35 metres	= Rs. 142.23
As 0.51 hectare metres	= 4.14 acre ft.
Therefore, cost for 4.14 acre ft. with a lift of 110 ft.	= Rs. 142.23

The cost of Energy for lifting 2.85 MAF through 33 metres

$$= \frac{142.23}{4.14} \times 2.85 \times 10^6 = \text{Rs. } 9.79 \text{ crores per year.} \quad \text{(i)}$$

Depreciation of pumping and Electrical equipment with maintenance per year has been taken as Rs. 105 per hectare vide Annexur 3.1 of Rajasthan Canal Project Stage II prepared by WAPCOS. This works out to Rs. 42.5 per acre.

Therefore, for 17.13 lakh acres the annual cost would be $17.13 \times 42.5 \times 10^5$ Rs. 7.28 crores (ii)

Therefore, total annual cost for converting 17.13 lakh acres from flow to lift irrigation will be cost of energy plus cost of depreciation of pumping etc. = (i)+(ii)

= 9.79 + 7.28 = Rs. 17.07 crores, say 17 crores.

= Rs. 99.6 per acre, say Rs. 100.00 per acre.

(b) Extra Annual Cost of Increased Lift On Saurashtra Branch

In the proposal of Gujarat, 4.62 lakh acres of the Saurashtra branch were to be served by lifting water through 101 ft. from the 300 canal. By Maharashtra proposal of 190 canal, this lift gets increased by additional 110 ft. The water requirement for this area (assuming 9.0 MAF for 54.02 lakh acres) is

$$4.62 \times \frac{9}{54.02} = 0.77 \text{ MAF}$$

The extra cost of energy for this increased lift is

$$\frac{142.23}{4.14} \times 0.77 \times 10^6 = \text{Rs. } 2.65 \text{ crores.}$$

Since cost of pumps have already been considered extra depreciation and maintenance is ignored (though there will be some extra cost for higher lift).

(c) Rajasthan's requirements of 0.5 MAF at the tail end of the canal will also have to ; lifted. Since the slope of 190 canal is considered to be parallel to that of 300 canal, lift of 110 feet is assumed.

$$\text{Therefore, Extra cost} = \frac{142.23}{4.14} \times 0.5 \times 10^6$$

= Rs. 1.72 crores.

To this amount should be added 1.56 crores computed as follows :—

Cost of depreciation of machinery (pumping and electrical equipment) (Annexure 3.1 of Exhibit R-290) = Rs. 925 per acre.

Therefore, for CCA of 3.67 lakh acres the cost is Rs. 155.97 lakhs.

Therefore, the annual cost of energy and equipment required for brining the command of 190 canal by flow and lift to that of 300 canal is 9.79 + 7.28 + 2.65 + 3.28 = Rs. 23.0 crores. It may be mentioned that it would be necessary to have link channels for feeding the distribution system, which has not been taken into account.

ANNEXURE X-2

Observations of Sediment Data of the Narmada River

Observation of sedimen data of the Narmada River is being made regularly from 1962 at the Garudeshwar gauging site in Gujarat. The data are given in Exhibits G-211 to 218, G-1089 to 1094 and G-1070. These have been tabulated in Statement 1 attached, indicating the quantity of silt in the size ranges of, Fine (0.075 mm and below), Medium (0.075 mm to 0.152 mm) and Coarse (0.152 mm and above,) and their respective percentages. The average values for the years of observation are given at the end of the statement.

Observations were also made at Mortakka intermittently for the Narmadasagar Project during the years 1951, 1952, 1956 to 1959 and 1962. Data of silt similar to that at Garudeshwar have been tabulated in Statement 2 attached.

The medium silt at Mortakka is nearly 30 per cent, while it is about 20 per cent at Garudeshwar. The observations, however, show a wide variation from year to year at the different sites. It is seen that the medium silt is quite significant.

Statement-1

Statement showing observed suspended sediment of river Narmada at Garudeshwar Gauging Station along with quantity and percentages of coarse,medium and fine silt for the years 1962—1976

Sl. No.	Year	Annual yield in MAF	Total observed sediment load in Mcft	Fine silt 0.075 mm & below in Mcft	Medium silt 0.152 mm to 0.075 mm in Mcft	Coarse silt 0.152 mm & above in Mcft	Total of medium plus coarse silt in Mcft	Percentage of fine silt %	Percentage of medium silt %	Percentage of coarse silt %	Percentage of medium plus coarse silt %	Detailed daily data in
1	2	3	4	5	6	7	8	9	10	11	12	13
1	1962	25.031	1036.01	897.41	127.08	11.52	138.60	86.63	12.26	1.11	13.37	G-211
2	1963	23.400	1056.74	886.35	157.80	12.59	170.39	83.89	14.93	1.18	16.11	G-212
3	1964	28.220	956.88	651.97	296.81	8.10	304.91	68.14	31.01	0.85	31.86	G-213
4	1965	10.669	458.64	445.70	11.80	1.14	12.94	97.19	2.57	0.24	2.81	G-214
5	1966	15.178	902.55	885.00	16.55	1.00	17.55	98.06	1.83	0.11	1.94	G-215
6	1967	30.399	2135.70	2055.00	74.50	6.20	80.70	96.22	3.49	0.29	3.78	G-216
7	1968	27.536	1553.20	1190.00	352.00	11.20	363.20	76.62	22.66	0.72	23.38	G-217
8	1969	39.971	2326.80	2090.00	214.00	22.80	236.80	89.82	9.20	0.98	10.18	G-218
9	1970	44.380	3318.20	3150.00	139.50	28.70	168.20	94.94	4.20	0.86	5.06	G-1089
10	1971	35.605	1321.17	1166.83	141.57	12.77	154.34	88.31	10.72	0.97	11.69	G-1090
11	1972	29.014	1075.00	969.07	94.23	11.70	105.93	90.16	8.76	1.08	9.84	G-1091
12	1973	63.883	1725.21	720.57	963.88	40.76	1004.64	41.77	55.87	2.36	58.23	G-1092
13	1974	20.972	738.03	61.47	632.29	44.27	676.56	8.33	85.67	6.00	91.67	G-1093
14	1975	38.747	1365.22	113.65	1226.19	25.38	1251.57	8.32	89.82	1.86	91.68	G-1094
15	1976 (Upto October)		998.05	759.51	225.10	13.44	238.54	76.10	22.55	1.35	23.90	Details not available Abstract G-1070
Total (1962—1975)		433.005	19969.35	15283.02	4448.20	238.13	4686.33					
Average (1962—1975)		30.93	1426.38	1091.64	317.73	17.01	334.74	76.53 (Per cent)	22.28 (Per cent)	1.19 (Per cent)	23.47 (Per cent)	
Total (1962—1973)		373.286	17866.200	15107.83	2589.72	168.48	2758.2					
Average (1962—1973)		31.11	1488.85	1283.98	215.81	14.04	29.85	84.57 (Per cent)	14.49 (Per cent)	0.94 (Per cent)	15.43 (Per cent)	

Statement-2

Statement showing observed suspended sediment of river Narmada at Mortakka Gauging Station for the years 1951 to 1952, 1956 to 1959 and 1962 with quantity and percentage of coarse, medium and fine silt

Sl. No.	Year	Annual yield in MAF	Total observed load in Mcft	Fine silt in Mcft	Medium silt in Mcft	Coarse silt in Mcft	Total of medium plus coarse silt in Mcft	Percentage of fine silt %	Percentage of medium silt %	Percentage of coarse silt %	Percentage of medium plus coarse silt %	Detailed daily data in
1	2	3	4	5	6	7	8	9	10	11	12	13
1	1951	10.937	782.66	508.60	265.82	8.24	274.06	64.98	33.97	1.05	35.02	
2	1952	17.517	1471.09	820.33	614.31	36.45	650.76	55.76	41.76	2.48	44.24	Narmada
3	1956	27.265	1254.60	1040.46	189.08	25.06	214.14	82.93	15.07	2.00	17.07	Sagar
4	1957	15.497	554.55	407.73	125.39	21.43	146.82	73.53	22.61	3.86	26.47	Project
5	1958	20.006	519.68	367.38	136.20	16.10	152.30	70.70	26.20	3.10	29.30	(1969)
6	1959	37.376	922.76	769.31	96.87	57.58	153.45	83.37	10.50	6.13	16.63	Annexure
7	1962	21.436	1103.29	643.42	431.92	27.95	459.87	58.32	39.15	2.53	41.68	V, Vol. II
Total		150.034	6608.63	4557.23	1853.59	191.81	2051.40					
Average		21.43	944.08	651.03	265.65	27.40	293.05	68.96 (Per cent)	28.14 (Per cent)	2.90 (Per cent)	31.04 (Per cent)	

Silting of the Reservoirs at Jalsindhi and Sardar Sarovar

The river Narmada carries a large quantity of sediment in its flood waters and with the construction of reservoirs along the river, most of this silt charge will be trapped by these reservoirs but some of it will also be drawn into the canals along with the irrigation water. The quantum of silt which will be deposited in any reservoir, per year is generally calculated on the basis of the catchment area of the river. Assuming a selected period of useful life, the silt which will be trapped in the reservoir is worked out. As the different factors responsible for silting are complex, estimation of such silting can only be considered in certain broad terms. Certain assumptions regarding the efficiency of the reservoir and the pattern of silting are made for simplicity.

2. *M/s. Borland and Miller in a paper on silting of reservoirs have suggested an approximate formula for determining the volume of silt which can be accumulated upto any selected point of elevation at the dam, called Area increment method. The approximate formula for the volume of silt which can be accumulated upto the outlet level of the dam is as follows:—

Vs =	AO (H—h)+Vo
Vo=	Capacity of the reservoir at outlet level in ac. ft.
Where Ao=	Area of submergence at that level in acres
Vs=	Total Volume of sediment in acre ft.
H=	Total ht from ground to normal water level in ft.
h=	ht from ground to outlet level in ft.

3. The formula assumes that the silt deposited may be considered as an inclined uniform prism lying along the river bed with a base area equal to the area of submergence at the elevation upto which the reservoir area is filled completely, the full capacity below that elevation also being considered as filled with silt. The height of the prism is considered as the height of water above that elevation. This is a very rough approximation. In actual practice the silt surface is not a straight line but is a complex line and requires elaborate calculation.

4. The above formula is recommended by the authors for use where the silt capacity does not exceed 15% of the total reservoir capacity. Where it exceeds this amount they suggest a more elaborate method called the emperical area-reduction method. In the present case the area-increment method is being used for the purpose of comparison, though it is strictly not applicable, for giving an approximate idea.

Silting At Jalsindhi Dam

5. The bottom of the penstock outlets of the Jalsindhi dam is at RL 300 where the capacity of Jalsindhi reservoir to that level is 0.1 MAF and the area of submergence is 5434 acres.

6. There are also 21 under sluices proposed for the dam with silt at RL 240. The effect of silt passed through these under sluices is not considered for the present. Applying the area-increment formula, the silt which can be accumulated upto the penstock outlets is

$$= \frac{5434 \times (455-300)}{10^6} + 0.15$$

$$= 0.99 \text{ MAF}$$

The volume of silt that is expected to be deposited at Jalsindhi dam in a period of 100 years is expected to be 0.9 MAF. Therefore, the penstock outlets would remain above the silt level for about 110 years. As already explained, this formula is strictly not applicable as the total capacity of Jalsindhi reservoir at RL 455 is about 2.9 MAF and the silt expected is more than 15 per cent of this capacity.

Sardar Sarovar Dam

7. The bottom of the inlets for the 300 canal is at about RL 280 where the capacity of the reservoir is 1.22 MAF and submergence area is 14,784 acres. Applying the area—increment formula, the volume of silt which can be accumulated in the reservoir upto the silt level is

$$\frac{14{,}784\ (455-280)}{10^6} + 1.22 = 3.81 \text{ MAF}$$

The volume of silt estimated for the Sardar Sarovar dam during a period of 100 years is about 1 MAF. Therefore, the canal outlets would remain above the silt level for about 380 years or more than 3 times that of the Jalsindhi reservoir. Here again the area increment method is not strictly applicable as the silt capacity is more than 15% of the total capacity of 7.7 MAF at RL 455.

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*Paper No. 3019—Transaction ASCE 1960 Distribution of Sediment in Large Reservoirs by BORLAND & MILLER

4 A&I/78—4.

Low Sardar Sarovar Dam

8. In the case of high Jalsindhi dam the States of Madhya Pradesh and Maharashtra have proposed that Gujrat's requirements may be met from a low Sardar Sarovar dam. For the +190 canal, the crest of this dam would be at a level of +210. Applying the area increment formula in the case of low Navagam dam, the silt which can be accumulated upto the silt level is

$$\frac{5162\ (210-180)}{10^6} + .024$$
$$= 0.39 \text{ MAF.}$$

9. If the interrupted catchment between the Jalsindhi dam and the Sardar Sarovar only were to contribute to the silting at Low Navagam Dam, the amount of silt deposited in a period of 100 years is about 0.1 MAF. Therefore, the canal silt would remain above the silt level for almost 400 years. However, this may not obtain due to other causes. The density currents will start bringing silt through the penstocks (and outlets if any) much earlier than 100 years before the reservoir space is expected to be filled upto penstock outlet levels of Jalsindhi dam and this will also be deposited in the reach between Jalsindhi Dam and Low Sardar Sarovar Dam. it is not possible, therefore, to estimate the life of the pond above low Sardar Sarovar Dam.

10. The quantum and the pattern of silting in a reservoir are dependent on several variable factors like the catchment characteristics, intensity of rainfall, variation in the flood peaks, nature of cultivation, shape of the reservoir, the method of operation of up stream reservoirs and the extent of withdrawals upstreams etc. No specific method has yet been evolved for taking into account all or even most of these variables. Only approximations and empirical methods are available. The problem becomes more complex when a series of reservoirs, as in the case of Narmada basin, are considered and it becomes impossible to make any estimate about the quantum of silt carried by the water. In general, even when clear water from a reservoir travels in the river, it picks up full load of silt in a very short distance. Sometimes the quantum of silt is, therefore, calculated on the basis of the volume of water flowing. The observations at Mortakka and Garudeshwar indicate that approximately 1 acre foot of silt is carried by 1000 acre feet of water. After construction of the various reservoirs upstream, approximately 13 MAF of water will be flowing during a year through Sardar Sarovar/Jalsindhi reservoirs. In a period of 100 years about 1300 MAF would be flowing through these reservoirs, which would be carrying 1.3 million feet of silt. The ratio of water entering the canal to that of water flowing into the sea would be about 10 MAF: 3MAF. Assuming that the water going to the sea takes its load of silts nearly 0.3 MAF will flow down in a period of 100 years leaving about 1MAF in the Sardar Sarovar reservoir/Jalsindhi. This more or less corresponds with the assumptions based on the catchment area. If the silt, which is likely to be deposited above the Low Sardar Sarovar Dam is considered with this approach, the rate of silting in this reservoir may be very much higher than in the earlier assumption of considering silt contributed by catchment area.

11. Further the accuracy of the silt observation is subject to the method of collection of samples. During high floods even velocity observations at Garudeshwar are made by sighting floating debris. The silt samples obtained from the banks are not expected to be representative. Though the Mortakka observations are said to be made at 0.6 depth it appears impractical to collect the samples at 0.6 depth during a flood, as the required equipment is generally not available, particularly when observations are made from the deck of a bridge much above water level. Therefore, the estimates of silt deposits can only be considered as rough approximations.

ANNEXURE X-4

Some of the important lined canals constructed in India, showing the bed-gradient provided for same.

Ref : Items 1 to 9 and 11 are given in Sardar Sarovar
Report—G-177, Vol. III page 383
Item 13 is given at page 19 of MR—102.

Sl. No	Name of the project or canal	Full Supply discharge in cusecs	Bed gradient
1.	Bikaner canal	2,144	1.3/10,000
2.	Haveli canal	6,000	1/10,500
3.	Thal Canal	10,000	1/6666
4.	*Nangal Hydel Channel	12,500	1/10,000
5.	*Tungabhadra Low Level Canal	1,323	1/10,000
6.	Sarda Sagar Project	7,500	1/6666
7.	*Nagarjunsagar Right Bank Canal	11,000	1/12,000
8.	*Nagarjunsagar Left Bank Canal	15,000	1/10,000
9.	*Tungabhadra Dam Project Left Bank (Hyderabad) Canal	7,000	1/10,000
10.	*Sundernagar Hydel Channel	9,000	1/6666
11.	Mahi Main Canal (Right Bank)	7,000	1/70000
12.	Lower Ganga Canal—Link Canal	7,500	1/9250
13.	*Rajasthan Canal Feeder	18,500	1/12,000

Remarks : Canals which take off from dams are marked*

NOTE :

Item 4 : This canal takes off from low Nangal Dam which is a diversion dam but Bhakra Dam about 7 miles upstream traps the heavy silt.

Item 13 : Rajasthan Canal feeder takes off at Harike Barrage which is downstream of Pong Dam on River Beas. Most of the heavy silt is trapped by that dam.

ANNEXURE X-5

Statement of area served by flow and lift as per different proposals

(Lakh acres)

Sl. No.	Proposal	By Flow		By Lift		Total
		In Gujarat	In Rajasthan	In Gujarat	In Rajasthan	
1	2	3	4	5	6	7
1.	+300 canal as proposed by Gujarat (1 in 10,000 upto Banni Br. and 1/6000 upto Rajasthan Border)	@49.40	*1.62	*4.62	*2.05	57.69
2.	+300 canal as proposed by Rajasthan (1 in 12,000 throughout)	54.15	*3.67	3.87	*Nil	61.67
3.	+190 canal as proposed by Maharashtra (1 in 20,000 upto Banni 1/10,000 upto Madka Branch and 1/6000 upto Rajasthan border)	@32.27	*0.37	@10.70 +11.05@@	*3.30	46.64 + @@11.05 (between +190 and +300 canals)
4.	+300 canal as suggested now. (1 in 12,000 upto Saurashtra branch, 1/10,000 upto Rajasthan Border)	52.99	£3.16	**3.93	£0.51	60.59

*From R—287

**From Item 1 in proportion to lift reduced from 101 ft. to 86 ft.

£From R—287 on proportionate basis.

@From Page 24 of note on FSL of canal.

@@From page 24 of note on FSL of canal. This is the area between +190 and +300 canals.

NOTE:—Figures for Serial No. 4 are only approximate.

CHAPTER XI

DETERMINATION OF THE HEIGHT OF SARDAR SAROVAR DAM

11.1.1 In this Chapter we propose to examine the crucial question of the determination of the height of Sardar Sarovar Dam proposed to be built by Gujarat across the river Narmada.

11.1.2 This question is the subject matter of modified Issues 6 and 13(b), which read as follows :—

Issue 6

> What should be the height of the dam at Navagam across the Narmada and what should be the level of the canal at its offtake with adequate discharge carrying capacity from the Navagam Dam ?

Issue 13(b)

> Should any directions be given for specification of FRL and MWL of the storage at Navagam Dam and the FSL of Navagam Canal so as not to prejudicially affect the interests of Madhya Pradesh, Maharashtra or the other concerned States ?

11.1.3 In Chapter IX of this Report, we have already decided that Gujarat should be allotted 9 MAF and Madhya Pradesh be allotted 18.25 MAF out of the utilisable quantum of 28.00 MAF of Narmada waters. In Chapter X of the Report, we have examined the question of the full supply level of Navagam Canal at its head and reached the conclusion that it should be +300 FSL.

11.1.4 On the basis of these findings, we proceed to examine the question of the FRL of the Sardar Sarovar Reservoir which has been the subject matter of acute controversy between the party States of Gujarat, Maharashtra and Madhya Pradesh in this case.

Utilisable Quantity of Water

11.2.1 It has been agreed by the party States and decided by the Tribunal in its Order and Decision dated 8th October, 1974, that the utilisable quantity of water of 75 per cent dependability in the Narmada at Sardar Sarovar dam site should be assessed at 28 MAF. The same figure has been arrived at in the Official Level Conference* in 1966 as under :—

75 per cent dependable flow	27	MAF
Evaporation losses from reservoirs	(—)4	MAF
Regeneration	(+)2	MAF
From carry-over	(+)3	MAF
	28	MAF

The figures adopted for evaporation, regeneration and carry-over had not been derived from any detailed studies. The actual figures could be different but it is clear that these three factors have to be taken into account in securing the utilisable quantum of 28 MAF in 75 per cent years.

11.2.2 Chronological inflow series for Sardar Sarovar Dam site derived from Exhibit G-1100(i) is given in Statement 11.1. This covers a period of 79 years from 1891-92 to 1969-70. The figures have been arranged in ascending order in Statement 11.1A. Likewise, inflow series for the 79 years at Narmadasagar dam site as derived from the same exhibit is given in Statement 11.2 and the figures are arranged in ascending order in Statement 11.2A. The inflow series for the intermediate catchment between Narmadasagar and Sardar Sarovar dam sites has been derived by subtracting the inflow at Narmadasagar from that at Sardar Sarovar in any year. This series is given in Statement 11.3 and is arranged in ascending order in Statement 11.3A. From Statement 11.1A, it will be noticed that the 75 per cent dependable inflow at Sardar Sarovar dam site is 27.01 MAF in 1958-59. To bring it up to 28 MAF, carry-over storage has to be provided in the various reservoirs taking into account evaporation losses from them and regeneration. The 75 per cent dependable inflow at Narmadasagar dam site is 20.72 MAF and that from the intermediate catchment 4.89 MAF as indicated in Statements 11.2A and 11.3A. These add upto 25.61 MAF. It would be reasonable to assume that in the 75 per cent dependable inflow of 27.01 MAF from the total catchment upto Sardar Sarovar dam, the contribution from the catchment above Narmadasagar dam and that below it would be in the ratio of 20.72 : 4.89. The contribution from the intermediate catchment can, therefore, be taken to be 5.16 MAF in an inflow of 27.01 MAF.

11.2.3 In an allocable quantum of 28 MAF, the distribution between the party States is as under :—

Madhya Pradesh	18.25	MAF
Gujarat	9.00	MAF
Rajasthan	0.50	MAF
Maharashtra	0.25	MAF
	28.00	MAF

The Navagam Canal would carry 9.0 MAF for Gujarat and 0.5 MAF for Rajasthan. Distributing the 75 per cent dependable inflow of 27.01 MAF in the above proportion between the party States, we get :—

Madhya Pradesh	17.61	MAF
Gujarat	8.68	MAF
Rajasthan	0.48	MAF
Maharashtra	0.24	MAF
	27.01	MAF

*Exhibit G-73, page 6.

The Sardar Sarovar reservoir thus gets from a 75 per cent dependable inflow of 27.01 MAF, 8.68 MAF for Gujarat and 0.48 MAF for Rajasthan, that is, 9.16 MAF.

11.2.4 It has been shown in paragraph 11.2.2 above that it would be reasonable to assume that in the 75 per cent dependable inflow of 27.01 MAF the contribution from the intermediate catchment would be 5.16 MAF. This figure is different from the corresponding figure of 75 per cent dependable inflow given in Statement 11.3A, and has been arrived at as explained in paragraph 11.2.2 above. Allowing for 0.24 MAF for Maharashtra, the remaining inflow from the intermediate catchment for Sardar Sarovar would be 4.92 MAF.

Regeneration and Evaporation below Narmadasagar excluding Sardar Sarovar

11.3.1 In all irrigation projects, a portion of the water utilised for irrigation returns to the stream as regenerated inflow. The percentage of the water which thus gets regenerated varies from project to project and depends upon (a) efficiency of irrigation; (b) the delta of water applied ; (c) the nature and depth of soil and (d) climatic factors. The party States have expressed divergent views as to the extent of water that would become available from regeneration. In our view it would be reasonable to assume for the reasons given in Annexure XI.1 that 10 per cent of the water withdrawn from the river for use in major, medium and minor projects would become available as regenerated inflow. Also, 60 per cent of the water utilised for industrial and domestic purposes within the basin may be considered as available for reuse. In Exhibit MP-1008 Madhya Pradesh has given figures for various water uses above and below Narmadasagar for allocations of 19.25 MAF and 17.25 MAF to Madhya Pradesh. It may be noticed that the figures are for withdrawals of 19.95 and 17.95 MAF instead of for 19.25 and 17.25 MAF. The figures of use, regeneration and evaporation loss for a withdrawal of 18.25 MAF have been worked out in Statement 11.4. The regeneration below Narmadasagar comes to 0.58 MAF. To this has to be added 0.02 MAF for regeneration from 0.25 MAF use in Maharashtra. The contribution from regeneration thus comes to 0.60 MAF. The evaporation loss in Madhya Pradesh below Narmadasagar is 0.68 MAF including 0.15 MAF from Harinphal and Jalsindhi reservoirs (Exhibits MP-527 and MR-37). Excluding these two (for reasons given later in this chapter) the loss works out to 0.53 MAF.

Evaporation Loss from Sardar Sarovar

11.4.1 There would be an appreciable evaporation loss from Sardar Sarovar and this has to be provided for in addition to the requirement of 9.5 MAF in Navagam Canal to meet the shares of Gujarat and Rajasthan. Taking into consideration the mean monthly temperatures and the reservoir level during the month, the annual loss works out to 0.5 MAF. This has been apportioned monthwise approximately on the pattern of Sardar Sarovar Project Report Volume I Exhibit G-177.

Carryover

11.5.1 The utilisable quantity of water of 75 per cent dependability has been assessed at 28 MAF. Allowing for evaporation loss from the various reservoirs and regeneration from the water use, the total quantity of water which has to be made available for the purpose works out to 29.29 MAF *vide* Statement 11.6. This can be secured only by providing carryover storage space in various reservoirs. From Statement 11.7 it is observed that this has to be 8.29 MAF in the whole of the river system. It is reasonable to assume that the carryover capacity should be provided in the reservoirs of Madhya Pradesh and in Sardar Sarovar more or less pro-rata to the water use there, that is in the ratio of 18.50 (including Maharashtra) to 9.5. On this basis a carryover capacity of 2.81 MAF is required as Sardar Sarovar and 5.48 MAF in the reservoirs of Madhya Pradesh. From Statement 11.8 it is noticed that for the representative year 1958-59 of 75 per cent dependability, there is an aggregate carryover capacity of only 3.454 MAF in Madhya Pradesh at and above Narmadasagar. Madhya Pradesh has not provided any carryover capacity in its projects below Narmadasagar. Madhya Pradesh should increase the carryover capacity in its reservoirs to an aggregate of 5.48 MAF or adjust the pattern of its water use.

Provision for Silt Storage

11.6.1 The basis and norm adopted by the party States for estimating silt deposition in reservoirs differ a great deal. In the Narmadasagar Project Report, prepared by Madhya Pradesh in 1969, a rate of silt yield of 1.15 acre ft./sq. mile/year for a catchment area of 23,800 sq. miles has been adopted. No allowance has been made for bed-load. Observations made at Mortakka gauging site had shown that of the total silt, 3 per cent was coarse, 28 per cent medium and 69 per cent fine silt. A broad assumption was made in the Report that of the silt reaching the reservoir, the entire coarse silt, 75 per cent of medium silt and 50 per cent of fine silt would get deposited there. In the Sardar Sarovar Project Report, prepared by Gujarat in 1971, a rate of silt yield of 1.49 acre ft./sq. mile/year has been adopted. This includes bed load at 11 per cent of suspended sediment. It has been assumed that 25 per cent of the fine silt, that is 0.33 acre ft./sq. mile/year would flow into Narmadasagar from its catchment area of 23,800 square miles and that fine silt would flow out at a similar rate from Sardar Sarovar on water spilling over during floods. The Report concludes that sediment to the extent of 4.036 MAF will accumulate in Sardar Sarovar in 205 years if Narmadasagar is built simultaneously. In the revised Jalsindhi Project Report, proposed jointly by Madhya Pradesh and Maharashtra in 1977, a norm of 1.26 acre ft./sq. mile/year has been adopted including an allowance of 10 per cent for bed sediment. No allowance has been made for silt which may flow down from Maheshwar dam or other dams located in the catchment below that dam.

11.6.2 On any major river, silt yield varies from reach to reach and depends upon a number of factors such as the magnitude and pattern of rainfall, the nature of soil in the catchment, ground slope, vegetal cover etc. No single norm can, therefore, be adopted

for various projects in the river basin. The extent to which silt will get deposited in a terminal reservoir during its useful life would depend on the size and type of the upstream reservoirs, their sequence and timing of construction, their surplusing arrangements and the mode of their operation. With such a large number of variables and inadequate observed data as in the present case, the provision required for silt storage becomes a matter of technical judgement. It would be reasonable to assume that the silt that would get deposited in Sardar Sarovar in a period of 100 years of its useful life would be of the order of 1.00 MAF of which 0.30 would get deposited in the live storage as per Annexure XI. 2.

Requirement at Sardar Sarovar

11.7.1 Of the allocable 28 MAF of 75 per cent dependability, the Navagam Canal would carry 9.0 MAF for Gujarat and 0.5 MAF for Rajasthan. Allowing for an evaporation loss of 0.50 MAF from Sardar Sarovar, the water requirement at the reservoir would be 10.00 MAF. The monthwise withdrawal of water from Sardar Sarovar for Gujarat is given in Statement 11.9 and the requirement at Sardar Sarovar in Statement 11.10.

Inflow Available for Sarovar from the Catchment below Maheshwar

11.8.1 As worked out in Statement 11.5, inflow from the catchment below Maheshwar is 2.960 MAF. The use below Maheshwar comprises that in Madhya Pradesh by four major projects, medium, minor, micro-minor and pumping schemes and evaporation loss in reservoirs and use by Maharashtra. There is some contribution from regeneration from these uses. Taking all these into account, the water that remains available for Sardar Sarovar from the inflow from the catchment below Maheshwar dam is 1.108 MAF as in Statement 11.5. Gujarat should receive this quantum in Sardar Sarovar in a monthly pattern conforming to the monthly inflow between Mortakka and Garudeshwar as given in Exhibit MP-312, Volume V, pp. 86-87.

Releases by Madhya Pradesh

11.9.1 In a year with 75 per cent dependable inflow of 27.01 MAF, 29.29 MAF has to be available allowing for evaporation loss and regeneration as in paragraph 11.5.1. There has thus to be 2.28 (29.29—27.01) of stored water available in the various reservoirs to ensure a utilisable quantity of 28 MAF. As the carryover capacity is to be provided in the ratio of water use, that is, 9.5 to 18.5 in Sardar Sarovar and reservoirs of Madhya Pradesh and Maharashtra, the share of carryover storage that should be available in Sardar Sarovar comes to 0.77 MAF. For the total requirement of 10 MAF at Sardar Sarovar, Madhya Pradesh would need to release at Maheshwar 8.122 MAF (10.00-1.108 inflow below Maheshwar-0.77 available in Sardar Sarovar). There is marked variation in the monthly requirement of Sardar Sarovar for Gujarat and Rajasthan as is evident from Statement 11.10. The requirement ranges between 0.439 in June to 1.212 MAF in November. Releases conforming to irrigation requirement of Sardar Sarovar would be unsuitable for power generation at the upstream projects, namely, Narmadasagar, Omkareshwar and Maheshwar, as that would result in a good deal of generating plant remaining idle for several months in a year. Madhya Pradesh has envisaged fairly uniform releases both from Narmadasagar and Maheshwar projects as is evident from Narmadasagar Project Report Volume II p. 231 (Exhibit MP-158) and Maheshwar Project Report (1972) Volume II p. 70 (Exhibit MP-326). It should be noticed that in either case, the difference between the maximum and minimum monthly release is not more than 20 per cent of the minimum. For preparing the working table for Sardar Sarovar, uniform release from Maheshwar reservoir of 0.677 MAF per month is adopted with adjustment for surplus or deficit flow.

Storage Required for Regulation Cum Carryover

11.10.1 The maximum aggregate carryover storage available in the various reservoirs would be 8.29 MAF of which 2.81 MAF would be in Sardar Sarovar. In preparing the working table, two successive years are considered, one which leaves the carryover capacity fully filled and the succeeding lean year which becomes successful by utilising the full carryover storage. The working table is in Statement 11.11. It may be noticed from the statement that a live storage of 4.20 MAF is required for regulation *cum* carryover.

Dead Storage

11.11.1 For Navagam Canal FSL +300 a minimum reservoir level of +307 would be required on providing for two feet working head at the head regulator and a loss of five feet in the approach tunnel and channels. The dead storage level in Sardar Sarovar would thus be +307 and the capacity at that level 1.68 MAF. This level and capacity is relevant only for operating the reservoir for irrigation alone. With power generation the dead storage will be the same as the minimum draw down level (MDDL) and as will be seen later on will be appreciably higher.

Gross Storage Capacity for Irrigation Alone

11.12.1 For operating the reservoir in the interest of irrigation alone the capacity required would be as under :—

	MAF
Dead storage	1.68
Space for silt deposition in life storage	0.30
Capacity for regulation *cum* carryover	4.20
Gross capacity	6.18

This corresponds to RL +436.

"Assurance" by Madhya Pradesh Regarding Regulated Releases

11.13.1 Madhya Pradesh has, in Exhibit MP-1196 filed in December, 1977, given the following "Assurance" :

"(1) For the Sardar Sarovar Dam with FRL 210 and any allocation upto and including 10

MAF of Narmada waters at 75 per cent dependability to Gujarat, Madhya Pradesh will give the necessary regulated releases at 75 per cent dependability to meet Gujarat's needs for consumptive use as may be determined and directed by this Hon'ble Tribunal. In the event of any shortfall in a 75 per cent dependability year in the allocated use (upto and including 10 MAF) in Gujarat with the Sardar Sarovar Dam FRL 210, Jalsindhi Dam FRL 420, Narmadasagar FRL 860 and other storages as proposed by Madhya Pradesh (CMP 432 of 1976 and MP-1019), Madhya Pradesh will bear the shortfall by restricting its irrigation and will make available the specified quantum (upto and including 10 MAF) in a 75 per cent dependability year allocated to Gujarat, as may be decided by this Hon'ble Tribunal. The regulated releases as aforesaid will be made subject to the condition that Gujarat will make such payment to Madhya Pradesh, as may be decided by this Hon'ble Tribunal for the benefits accruing to Gujarat on account of such regulated releases."

11.13.2 In G-1282, Gujarat filed a reply to the "Assurance of Madhya Pradesh". Gujarat pointed out that the so-called assurance is based on the assumption that the FSL of Navagam Canal is restricted to +190 and the FRL of Sardar Sarovar to +210. In Ex R-304, Rajasthan also said that Madhya Pradesh has given no assurance to Rajasthan and in any event the "assurance" is unacceptable as it is based upon the hypothesis of FSL 190 canal with a slope of 1 in 12,500 and it does not even reach Rajasthan border. In Chapter X, we have held for the reasons therein given, that for enabling Gujarat and Rajasthan to effectively utilise their respective allocated shares of Narmada waters for irrigation, the FSL of the canal should be fixed at a minimum level of +300. The so-called "assurance" of Madhya Pradesh is really a conditional offer and is not acceptable as the assumption on which it is based is illusory and untenable.

11.13.3 The assurance is ineffective even for Sardar Sarovar FRL +210 and Navagam Canal FSL +190. With releases conforming to the monthly requirements of Navagam Canal which the assurance implies, a good deal of generating plant at Narmadasagar, Omkareshwar, Maheshwar and Jalsindhi would remain idle for several months in a year. Even if such an uneconomic use of power plant is accepted by Madhya Pradesh and Maharashtra it still leaves a problem. It is also very significant that a dam of FSL +210 at Sardar Sarovar neither provides any capacity for carryover storage to secure 28 MAF of water of 75 per cent dependability nor for storing inflows surplus to that of 75 per cent dependable use. For securing 28 MAF of 75 per cent dependability, a carryover capacity of 2.81 MAF has to be provided at Sardar Sarovar as shown in paragraph 11.5.1 ante. In its absence it would not be possible to comb flood flows from the catchment below Narmadasagar and a good deal of utilisable water would flow down to sea unutilised which should not be allowed and which cannot be contemplated. Also in the absence of any capacity in Sardar Sarovar to store surplus inflows which party States are allowed to utilise in proportion to their share of water, Gujarat would not be able to utilise its share of these. From the above considerations it is evident that the assurance given by Madhya Pradesh is illusory and unacceptable.

Effect on Jalsindhi and Harinphal Projects

11.14.1 The Jalsindhi Hydro-electric Project (1970) jointly sponsored by Maharashtra and Madhya Pradesh was designed for FRL +355 and tail race level (TRL) +210. The Harinphal Project (1975) of Madhya Pradesh stipulated a FRL +420 and TRL +355. In the revised Jalsindhi Project (1977) jointly proposed by Maharashtra and Madhya Pradesh in lieu of the previous Jalsindhi and Harinphal projects, FRL+ 420 and TRL +210 have been adopted. With FRL +436 required at Sardar Sarovar even for irrigation use alone, the Harinphal Project and the Jalsindhi Project, original and revised, become unfeasible.

FRL With Power Generation

11.15.1 With Jalsindhi Project becoming unfeasible, the power potential of the project would be lost to Madhya Pradesh and Maharashtra. In the interest of these States, therefore, it becomes necessary to generate power at Sardar Sarovar to make good the loss of this potential. With a uniform discharge throughout the day, there would be varying inflows into the pond at the canal head from the tail race of the power house due to diurnal variations in power demand as the power house would be a peaking station. There would thus be fluctuations in the pond level. In Exhibit G-802, Gujarat has indicated the range of variation in the pond level to be 10 feet for Navagam Canal FSL +300. This figure is for an allocation of 13.4 MAF for the canal with Sardar Sarovar FRL 530. Gujarat has adopted load factors varying from 32 per cent to 74 per cent in different months depending upon the average head available during the month. With 9.5 MAF let into the canal in a year, the maximum monthly drawal for Gujarat and Rajasthan would be 1.17 MAF in November *vide* Statement 11.10. With this rate of flow into the canal and taking a load factor of 50 per cent the storage required in the ponds for re-regulation would be 0.02 MAF.

11.15.2 Allowing for 2 feet working head at the head regulator of the +300 FSL canal the minimum pond level would be +302. The maximum pond level to accommodate 0.02 MAF above +302 would be +312 (approximately). There is a minimum operating head below which the generating units have to be stopped for technical reasons. With FRL +436, the MDDL works out to $\left(\frac{436-302}{3}+312\right)$ = RL+357. Under these conditions because the reservoir level would go below MDDL +357 in operating the reservoir for irrigation, there would be no power generation in about six months of the year and during that period the plant capacity would remain idle. In order to generate power throughout the year it would be necessary to provide all the live storage above MDDL for which a FRL + 453 with MDDL + 362 would obtain as under :—

	MAF
Dead storage (MDDL +362)	2.94
Space for silt deposition in live storage	0.30
Capacity required for regulation and carryover	4.20
Gross capacity	7.44

This corresponds to RL +453.

Proper FRL of Sardar Sarovar

11.15.3 Taking into consideration the carryover capacity required for ensuring 28 MAF of 75 per cent dependability, the requirement for re-regulation at Sardar Sarovar for feeding Navagam Canal, the space required for silt deposition in the live storage, and the need to generate power at Sardar Sarovar in lieu of generation at Jalsindhi, the full reservoir level comes to +453. We, however, consider that the FRL of Sardar Sarovar should be fixed at +455. At this level the gross capacity of the reservoir comes to 7.7 MAF. It is significant to notice that this level was adopted by Madhya Pradesh for Harinphal reservoir in the 1972 Project Report. It is below the tail race level +457 of Maheshwar Project and, therefore, would not interfere with the functioning of Maheshwar power house. The capacity between RL 453 and 455 is 0.20 MAF (7.70−7.50) which would store some additional water from surplus years to be utilised by the party States in proportion to their apportioned shares. Madhya Pradesh would get nearly two-thirds of it. The submergence of land between these two levels is 3000 acres gross of which 1000 acres is cultivable, *vide* Exhibit MP-902. This is not excessive, and in view of the countervailing benefit, our considered opinion is that the FRL of Sardar Sarovar should be +455 providing gross storage of 7.70 MAF.

FLOOD CONTROL

High Flood Gauges

11.16.1 Record of observed flood discharges on the Narmada is available only for a period of 26 years from 1948 to 1973. During this period, the peak gauges at Mortakka and Garudeshwar in three years of very high flood were :—

	Mortakka	Garudeshwar (RL in feet)	Reference
1968		129.40**	*MP-515
1970	562.84*	136.63**	**G-177, Vol. II, p. 217
1973	568.60*	131.83***	***G-734, p. 27

The 1970 flood, occuring in September, was the highest on record at Garudeshwar though not at Mortakka. This was due to a disproportionately high inflow from the catchment area below the latter. At Mortakka, it was the August 1973 flood that was the highest. That year the flood inflows from the catchment below Mortakka were relatively small and in consequence Garudeshwar gauge remained relatively low.

Peak Flood Discharge at Garudeshwar

11.16.2 Garudeshwar gauge site is 7 kms downstream of Sardar Sarovar dam site 3. The distance being short and the catchment between the two sites being small, the discharge at the dam site is taken to be the same as that at Garudeshwar. Gujarat has stated and Madhya Pradesh has tacitly accepted that the 1970 peak flood discharge at Garudeshwar was 24.50 lakh cusecs. But Maharashtra has contended that it should be taken to be 18.375 lakh cusecs. (see Exhibit MR-142). It has pointed out that during the September 1970, flood discharges were measured by Gujarat by current meter upto 6.21 lakh cusecs, by compartmentwise floats upto 13.63 lakh cusecs and by single point float above that discharge. Further it has stated, that the margin of error in observation can be 5 per cent with current meter and 10 per cent with multicompartment floats and 25 per cent with single point floats. Gujarat, in arriving at the peak flood discharge of 24.50 lakh cusecs, has relied on a number of methods of computing it but Maharashtra has pointed out some lacuna in each. It is evident that the peak discharge figure of Gujarat errs on the high side. It is, however, difficult to quantify the exact extent of the error.

Design Flood

11.16.3 Both Gujarat and Maharashtra have indicated figures for the 1000-year design flood at Sardar Sarovar dam site. Gujarat has derived a figure of 30.7 lakh cusecs from a statistical analysis of the past records including the highest observed flood of 1970. (See Exhibit G-723). Maharashtra has contended that the procedure adopted by Gujarat was not correct as certain values were neglected in the analysis. Moreover, the figures for the highest observed floods should be reduced on account of errors of observation. With these changes, Maharashtra derived a figure of 24.99 lakh cusecs. Gujarat has constructed a hydrograph for the 1000-year design flood of 30.7 lakh cusecs by proportionally increasing ordinates of the hydrograph of the 1970 flood, taking the peak of that flood to be 24.5 lakh cusecs. If Maharashtra's contentions are accepted the peak of the 1000-year design flood would be only 24.99 lakh cusecs and the hydrograph for it would be the one prepared from the modified hydrograph of 1970 after making the necessary changes pointed out by Maharashtra.

11.16.4 The maximum observed flood (1970) at Sardar Sarovar and in consequence the derived 1000-year flood there has two components, namely, the inflow from the catchment above Narmada Sagar and that from the catchment below it. The former would get moderated on the construction of Narmada Sagar and upper dams but not so the latter. In considering the MWL at Sardar Sarovar, the 1000-year design flood to be taken into account should be with moderated outflows from Narmada Sagar and unmoderated inflows from the catchment area below Narmada Sagar.

Moderated Outflows from Narmadasagar

11.16.5 Flood moderation studies for Narmadasagar have been carried out by Madhya Pradesh and

Gujarat for the observed flood of 1970. Madhya Pradesh has expressed its intention to complete within 15 years, 10 major dams above and including Narmadasagar. Of these 10 dams, Tawa and Barna have been completed. The main flood moderation upto Narmadasagar would, however, be from that reservoir itself. Gujarat has estimated that the peak flood release from Narmadasagar for the 1970 flood would be 12.46 lakh cusecs (Exhibit G-1059). On the other hand, according to Madhya Pradesh it would be 9.58 lakh cusecs (Exhibit MP-1009). In making these estimates both have assumed the existence of upper Burhner, Bargi, Barna, Tawa and Narmadasagar reservoir, but their assumptions and method of calculations differ. Madhya Pradesh has claimed in Exhibit MP-515 that on construction of all the major dams in the basin in that State, a flood of the magnitude of 1970 would get moderated to 6.86 lakh cusecs. For the reasons given in Annexure XI-3 we consider that this figure cannot be accepted as it appears to be too low. In our view, it would be feasible to restrict the outflow from Narmadasagar to 10 lakh cusecs without encroaching on the MWL +864 there in a flood of the magnitude of the 1970 flood. However, the peak outflow would be higher in a design flood but can be restricted to about 13.5 lakh cusecs without encroachment on MWL at Narmadasagar.

The Proper MWL

11.16.6 In determining the proper MWL for Sardar Sarovar, apart from consideration of submergence, the maximum flood to be routed through the reservoir, the number and size of the spillway gates, their sill level and the level at which the flood would impinge have all to be considered. If gates are kept shallow higher MWL will obtain. In the Sardar Sarovar Project Report (1971), 26 radial gates 46 feet high and 51 feet wide have been provided. It is suggested that the height of the gates should be increased to 55 feet with sill level at +400. In the Jalsindhi Project Report (1977), jointly sponsored by Madhya Pradesh and Maharashtra, gates of this height have been proposed.

11.16.7 Keeping in view the problem of submergence, the magnitude of the design flood and the spillway capacity, we consider that an MWL of +460 at Sardar Sarovar would be appropriate. With FRL at +455, this would give a flood lift of 5 feet. In the revised Jalsindhi Project Report (1977), a FRL of +420 and a MWL of +425 have been adopted giving a flood lift of 5 feet. The earlier Harinphal Project Report (1972) envisaged a MWL of +460.6.

11.16.8 At the beginning of the rainy season in July, the reservoir level at Sardar Sarovar, even in a surplus year, is not likely to be more than +400. In the early part of the season, the flood inflows above Narmadasagar would be practically used up in filling that and the upstream reservoirs. During this period Sardar Sarovar would receive flood inflows from the catchment area below Narmadasagar. From mid-August onwards, with upstream reservoirs mostly full, Sardar Sarovar would have the full impact of floods. In the past, floods have not been experienced after 20th September. Therefore, the crucial period for flood moderation at Sardar Sarovar would be from mid-August to 20th September. It would be a good working arrangement to keep the reservoir level during this period below +450. For passing Maharashtra's estimated 1000—year flood of 24.99 lakh cusecs the reservoir level would need to be lowered by 5 feet to +445 to receive the flood in order not to exceed MWL +460. For passing Gujarat's 1000—year flood of 30.7 lakh cusecs without exceeding the MWL, it would be necessary to enlarge the spillway capacity by adding two more gates and bring down the reservoir level to about +440. At the falling stage of the season's last flood, the reservoir can be replenished to FRL +455. Should another flood occur the process will have to be repeated.

11.16.9 Before the flood outflows from Narmadasagar reach Sardar Sarovar there would be a time interval of 18 to 20 hours. It is presumed that there would be reliable communication between Narmadasagar and Sardar Sarovar regulating stations with more than one means, such as telephone, wireless and carrier system on high tension lines. Therefore, the lowering of Sardar Sarovar to the required level on a flood arriving at Narmadasagar should not be difficult or involve any risk.

11.16.10 Because of the method of observation used by Gujarat during the 1970 flood, a dependable figure for the 1000—year flood cannot be arrived at. It would be necessary for Gujarat to make fresh assessment in the light of further flood observations that may be made with better technique and formulate procedure for reservoir operation ensuring that the maximum reservoir level does not rise above +460. The spillway capacity should be designed by Gujarat to ensure the safe passage of design flood which may be reappraised. In the early years the reservoir should be operated cautiously by keeping the levels low.

Flood Outflows from Sardar Sarovar

11.16.11 During a flood, the spillway gates at Sardar Sarovar shall have to be so operated that the peak outflow discharge is kept minimum without the reservoir level rising above MWL +460. In a flood of the magnitude of 1970, estimated at 24.50 lakh cusecs by Gujarat and 18.37 lakh cusecs by Maharashtra, with outflows from Narmadasagar restricted to 10 lakh cusecs the peak outflow from Sardar Sarovar would be about 16 lakh cusecs for the Gujarat figure of the flood and about 11 lakh cusecs for the Maharashtra figure. In a 1000—year flood of 24.99 lakh cusecs estimated by Maharashtra with outflows from Narmadasagar moderated to 13.5 lakh cusecs, the peak outflow from Sardar Sarovar would be about 16 lakh cusecs without exceeding MWL +460. However, for passing Gujarat's 1000-year flood of 30.7 lakh cusecs with enlarged spillway and level of flood impingement of say +440, the peak outflow would be of the order of 22 lakh cusecs.

11.16.12 Gujarat has desired that flood discharge below Sardar Sarovar should be limited to 12 lakh cusecs but has recognised that moderation of design flood below 16 lakh cusecs may not be possible. Even for 12 lakh cusecs, it would be necessary to construct

flood embankments for the protection of areas in the flood plains and Broach town. The return period of the 1970 flood has been stated by Maharashtra to be 88 years (Exhibit MR-142, p. 100) while Gujarat has figured out the period to be 150 years (Exhibit G-723, p. 73). Flood embankments are generally provided for floods of a return period of 100 years, risk being accepted for higher floods. It would be quite practicable to provide embankments for the moderated 1970 flood outflows from Sardar Sarovar mentioned in paragraph 11.16.1. A greater moderation of flood would require a higher MWL at Sardar Sarovar involving submergence of larger area under the reservoir. This is not considered justified. A MWL of +460 should be adopted for Sardar Sarovar Reservoir.

11.16.13 For the reasons expressed, our decision is that the height of the Navagam Dam should be fixed at Full Reservoir Level +455 and Maximum Water Level +460. Issue 6 and Issue 13(b) are answered accordingly.

Advice of the Assessors

11.17.1 We have consulted our technical Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this Chapter. They have advised us that they all agree with the conclusions reached in paragraphs 11.15.3 and 11.16.13 and also the reasoning given by us in the previous paragraphs for reaching those conclusions.

ANNEXURE XI-1

Regenerated Inflows

1. In Irrigation Projects a substantial portion of the water which is in excess of the evapo-transpirationr equirement of the crops-irrigated becomes available for reuse downstream of the irrigated area. When irrigation is done copiously, part of the excess water percolates to groundwater table and part drains out of the field as surface flow. The percolated water reappears in the stream as regenerated inflow and the excess surface water as return flow. Both together determine the quantum of water available for reuse. In the proceedings before us the term regeneration has been somewhat loosely applied of the total quantum of water available for reuse which is really relevant.

2. In considering regeneration, which term is taken to embrace return surface flow also, the aspects which need to be dealt with are—

(i) The class of projects which contribute to regeneration.

(ii) The period in a year during which regeneration contributes.

(iii) Regeneration as a percentage of water used.

Projects Which Contribute To Regeneration

3. In compliance with the Tribunal's orders dated 11-8-1975, 19-1-1976 and 13-4-1976, Madhya Pradesh and Gujarat filed working tables for the Narmadasagar and Sardar Sarovar reservoirs under MP-861 to 865 and G-973 to G-980 for various allocations. In these studies varying standards were adopted by the two States. For the sake of uniformity of procedure and assumptions to be adopted by the party States in preparing the working table, the Tribunal issued directions on 9-8-76, directing *inter alia* that regeneration may be considered at 10% of the use from all major, medium and minor projects excluding micro-minor and pumping schemes. While complying with these directions, the party States expressed their own views also in the matter. Madhya Pradesh held that regeneration should be accounted for on the basis of the aggregate use of water in major, medium, minor, micro-minor and pumping schemes. Gujarat on the other hand stated that "if at all regeneration is to be considered, it should be with respect to the consumptive use from major projects only" *vide* Exhibit G-1242 (July 1977). Maharashtra has, in Note 35 (February 1977) p.35, stated that "the minimum reasonable figure for regeneration in the long term in the conditions obtaining in the Narmada basin in Madhya Pradesh should be 20 per cent of the withdrawals for upstream projects, but the ultimate return flows may be even larger." Maharashtra, thus, makes no distinction regarding the size or class of projects which contribute to regeneration. The Krishna Water Disputes Tribunal in its report, 1973, p. 22 had classified projects utilising more than 3 TMC of water annually as major projects and those utilising 1 to 3 TMC as medium projects. The Krishna Water Disputes Tribunal considered regeneration from major projects only.

4. Regeneration is a function of the efficiency of irrigation, the delta of water applied, and the nature and depth of soil and climaet. So long as these factors are similar, the percentage regeneration would be practically the same irrespective of the size of a project. Micro-minor projects, however, do not generally provide adequate irrigation supply and regeneration from them is insignificant. Pumped water is expensive and, therefore, it is used by irrigators with great economy and there is insignificant regeneration from it. Therefore, in-calculating probable regeneration it would be reasonable to consider only major, medium and minor projects.

The Period of Regeneration

5. Madhya Pradesh has stated that "the assumption made by it in the working tables (MP-861 to MP-865) that regeneration will be available during the non-filling period only is a proper and correct assumption" *vide* Exhibit MP-893 paragraph 2-1-2. Gujarat pointed out in Exhibit G-973 paragraph 2.12 that Madhya Pradesh in its own projects had not followed any uniform practice for the period of availability of regeneration flow in a year. Gujarat has stated that "the regeneration from the irrigation use as well as from the industrial and domestic use should be considered as available uniformly throughout the year" *vide* Exhibit G-1242 page 55 paragraph 7.1. Maharashtra has averred that "regeneration is the return flow from the losses due to percolation and excess supplies over the consumptive uses occurring in the monsoon months reappearing as gains (return flow) in the river in the non-monsoon months" and that "the entire regeneration should be taken as available throughout the non-filling period" *vide* Maharashtra Note 35 pp. 40-41 (February 1977).

6. In a river basin with no canal irrigation in it, water table is lowest before the break of rains and highest towards the end of the rainy season. The rise is due to percolation from rainfall. The visible regeneration in a stream is maximum shortly after the rainy season when the river level goes down and the groundwater table is high. With the fall in the level of groundwater table, the regenerated flow decreases. With the introduction of irrigation in the basin, groundwater table still behaves in the same fashion, rising to the highest level at the end of the rainy season and dropping to its lowest level before the rainy season. Only the levels become higher with the percolation from irrigation supplies added to that from rainfall. The general rise in the water table is affected by the extent to which groundwater is exploited and in extreme cases may even get lowered if groundwater is extracted in excess of what is put in by irrigation. With no change in the extraction of groundwater, regeneration must increase with the introduction of irrigation and that would follow the pattern of water use for irrigation from month to month with some lag. The higher water level in the river during its high stages would defer the regeneration flow into it but would not affect the total contribution of regeneration from irrigation use of water. The same would hold good for reservoirs. It would appear reasonable to assume that in a year the monthly contribution of regenerated flow attrributable to irrigation

would be commensurate with the water used allowing for a period of lag, which may not be uniform. The excess irriagation water applied to a field which drains off as surface flow takes a much shorter time to reach the stream than the component which goes through the subsoil for regeneration. Therefore, where irrigation is done copiously as for rice, the contribution from return flow is rapid. There are several factors which influence the period of lag between the use of irrigation water and the appearance of regenerated flow and these factors vary from project to project. No precise experimental data are available which can help in making an assessment of the period of lag in any particular case. But from various considerations it would appear reasonable to assume a lag of a month as a working hypothesis. Therefore, in our view, the contribution from regenerated flow, which includes return surface flow should be taken commensurate with the water use during the previous month. The contribution from water used for domestic and industrial purposes would be more or less uniform throughout the year.

Regeneration As A Percentage of Water Used

7. Madhya Pradesh in its Master Plan for development of water resources of the Narmada has stated that "though a somewhat higher percentage of diversions made for irrigation is likely to come back to the river, the regeneration has been taken at 10% in the Master Plan", *vide* Exhibit MP-312 Vol. 1A p.6. Madhya Pradesh adopted this figure also in December 1976 in its Written Submission Vol. VII at p.161. As regards industrial and domestic use of water, it has stated that "the consumptive use for industries has been worked out at 40 per cent of the plant use within the basin and 100 per cent for plant use outside the basin as for domestic supply because the conditions are similar" *vide* Exhibit MP-312 Volume I p.164. Thus Madhya Pradesh has assumed that 60 per cent of the water drawn for industrial and domestic use within the basin would be received back as return flow.

8. Dealing with the question of return flow the Krishna Water Disputes Tribunal observed in its Further Report 1976 as under :

"The parties agreed that a percentage of the excess utilisation for irrigation in the Krishna basin from projects using 3 TMC or more would appear as return flow and would augment the 75 per cent dependable flow of 2060 TMC. We found that this return flow could safely be taken to be 7½ per cent of the excess utilisation after 1968-69, see Report Vol.1 pages 85-86" Ibid p.10. "In estimating the return flow as 7½ per cent and not 10 per cent of the excess utilisation for irrigation after 1968-69, we omitted to take into account the effect of prolonged and continuous irrigation in the Krishna basin from projects using 3 TMC or more annually since 1951 upto 1968-69 and after 1968-69. Had we considered this aspect of the matter we would have estimated the return flow as 10 per cent of the excess utilisations after 1968-69. On consideration of all relevant materials we hold that on a safe and conservative estimate 10 per cent of the utilisations for irrigation in the Krishna Basin after 1968-69 from projects using 3 TMC or more annually over the utilisations for such irrigation in 1968-69 from such projects will appear as return flow in the Krishna basin and will augment the 75 per cent dependable flow of 2060 TMC of the river Krishna upto Vijayawada" Ibid p.11.

9. Gujarat had taken the stand that "the regeneration flow is an uncertain and erratic phenomenon and should not, therefore, be taken into account" *vide* Exhibit G-1242 p.7. Later, however, it modified its stand and stated :—

"The reason given by the Krishna Water Disputes Tribunal for taking regeneration at 10 per cent of the excess utilisation after 1968-69 from the projects utilising 3 TMC or more would be applicable in the case of Narmada basin also and hence regeneration should be taken at 10 per cent of the utilisation from major projects in Madhya Pradesh" *vide* Exhibit G-1242 p.19.

10. Maharashtra stated that "the minimum reasonable figure for regeneration in the long term in the conditions obtaining in the Narmada basin in Madhya Pradesh should be 20 per cent of the withdrawals for the upstream projects, but the ultimate return flows may even be larger" *vide* Maharashtra Note 35 pp 35-36, February, 1977. In Maharashtra's Working Tables a regeneration of 20 per cent of the upstream utilisations has been adopted (Ibid. p.38).

11. In the very nature of things, regeneration and return flow do not lend themselves to any precise estimation. Regeneration depends upon the quantum of irrigation water that percolates to the ground-water table and the extraction of groundwater for various purposes. If extraction by means of open wells or tubewells exceeds the quantum that percolates to the groundwater table from irrigation and rainfall, there would be little regeneration from groundwater. As regards surface return flow from irrigation use, it would depend upon how lavishly or economically irrigation water is utilised. Considering that the demand for water by the party States far exceeds the availability, water in the Narmada basin will need to be utilised economically. After considering the various factors discussed in this note, we think that in the present case, regeneration, including return flow, should be taken as 10 per cent of irrigation use in the upstream major, medium and minor projects in the Narmada basin in any month with a lag of one month. Also 60 per cent of the water used for domestic and industrial purposes within the Narmada basin may be taken as return flow available uniformly throughout the year.

Silt Deposition in Sardar Sarovar

For a hundred year useful life of the reservoir, a total silt deposition of 1.0 MAF has been assumed. Part of this silt will get deposited in the live storage space of the reservoir. Messrs Borland & Millar, in a paper on 'Distribution of Sediment in Large Reservoirs' have suggested an area-increment method of predicting distribution of sediment in a reservoir. They have suggested that following empirical formula :—

$$Vs = Ao\,(H-h)+Vo$$

Where
- Vo = Capacity of the reservoir at outlet level in acre feet.
- Ao = Area of submergence at that level in acres.
- Vs = Total volume of sediment in acre feet.
- H = Total height from ground to normal water level in feet.
- h = Height from ground to outlet level in feet.

Applying this formula it is seen that 1 MAF of silt can be accommodated at RL +142. The area of submergence at this level is 2901 acres. Considering an FRL +455 and an MDDL of +363, the amount of silt which is expected to be deposited in the live storage is:

$$2901 \times \frac{(455-363)}{10^6} = 0.30 \text{ MAF. (Approx.)}$$

ANNEXURE XI-3

Flood Moderation By Madhya Pradesh Reservoirs

1. Madhya Pradesh submitted a monograph, Exhibit MP-515 (December 1974) prepared by Shri Kanwar Sain, former Chairman, Central Water & Power Commission. This Study summarises and supports the contention of Madhya Pradesh that the reservoirs proposed in its Master Plan would moderate floods of the magnitude of the highest observed flood of 1970 to a safe limit of 12 lakh cusecs below Sardar Sarovar and that no specific flood control measures were, therefore, required at Sardar Sarovar. Gujarat has disagreed with this contention *vide* its rejoinder in Exhibit G-695. It has pointed out that during such high floods the major contribution is from the catchment below Narmadasagar. This peculiar characteristic, according to Gujarat, has a significant bearing on the effectiveness or otherwise of the flood forecasting and floood-warning system which may be adopted for flood-regulation below Narmadasagar.

2. In the study, Exhibit MP-515, it has been assessed that the only flood moderation capacity in the various reservoirs would be what would be available between the full reservoir level (FRL) and the maximum water level (MWL) and that no other specific capacity for the purpose would be provided. It has been proposed in the Study that pre-releases may be made from the various reservoirs on receipt of storm warning and flood warning in anticipation of the arrival of a flood so that some additional storage capacity is vacated below FRL for moderating the flood. In the Study the basin is divided into three zones, viz., (1) upto Bargi, (2) between Bargi and Narmadasagar and (3) between Narmadasagar and Harinphal. It has been assumed that the flood absorption capacities of the major reservoirs which lie upstream of Bargi would be notionally available in aggregate at Bargi, of those between Bargi and Narmadasagar at Narmadasagar and of those between Narmadasagar and Harinphal at Harinphal which is considered as a terminal reservoir. Hypothetical MWL at each of the three sites, Bargi Narmadasagar and Harinphal corresponding to the aggregate capacity has been adopted for the flood study.

3. Because of some unrealistic assumptions made in the Study, Exhibit MP-515, the moderated flood below Narmadasagar worked out in it is unacceptably low. Commenting on this Study, Gujarat has, in Exhibit G-695, pointed out the wrong assumptions the more important of which are discussed below :

(i) Clubbing together of flood cushion, the space between FRL and MWL of a number of reservoirs at one site for the purpose of simplification of flood moderation computation is not realistic (Ibid p. 25). The higher MWL due to clubbing increases the rate of outflow in the routing studies resulting in the requirement of smaller flood cushion.

(ii) The assumption that the flood cushion in all the reservoirs will be fully operated upon irrespective of the magnitude of the flood at the respective sites is also not correct since rainfall concentration in catchment varies. Moderation would also not be cumulative. (Ibid p. 25).

(iii) Madhya Pradesh has carried out the flood routing studies considering the 1970 observed flood in Narmada. In the study, the contribution from the intervening catchment has not been computed properly. For example, the moderated flood at Narmadasagar has been considered as moderated flood at Bargi plus direct arithmetical difference between the peaks of Narmadasagar and Bargi without taking into account the effect of time and space i.e. the peak of flood from Bargi and the peak of flood from the catchment between Bargi and Narmadasagar is considered as synchronised. This assumption is not justified. (Ibid p. 26).

(iv) The details of observed floods at Jamtara, Mortakka and Garudeshwar along with travel time, indicated in MP-515 show that the flood at Bargi must have passed the Narmadasagar site earlier than the peak at Narmadasagar, indicating that the contribution of the Bargi flood to the flood peak at Narmadasagar is negligible. The deduction of the peak at Bargi occurring on 2-9-70 from that at Narmadasagar occurring on 6-9-70 to arrive at the contribution from the intervening catchment is not correct. (Ibid pp. 27-30).

(v) A part of the valley storage will be lost due to construction of reservoirs and the flood peak would become higher. This should be allowed for. (Ibid p. 15).

(vi) The Plan of operation of the spillway at Bargi and Narmadasgar adopted in Exhibit MP-515 is different from that adopted in the Project Reports. As per Project Reports, reservers at Bargi and Narmadasagar are proposed to be operated for flood routing adopting outflows equal to inflows so as to maintain water level at FRL upto flood of 11.3 lakh cusecs and 12 lakh cusecs respectively after which the reservoir is allowed to rise and flood moderation becomes operative. However, in the study presented in Chapter 6 of Exhibit MP- 515, the use of flood moderation space has been commenced with much lower inflows, resulting in excessive flood moderation. (Ibid pp. 31-34).

(vii) It has been assumed in the Monograph that with the help of reliable system of flood forecasting and flood warning it would be possible to deplete the reservoirs and thus provide substantial space between full reservoir level and crest level in advance (MP 515 p. 36). Gujarat has expresssed the view that it would not be possible to rely on advance forecasting for phasing advance releases and in some cases it may even prove misleading particularly when the floods are flashy and are due to storms concentrated in the lower part of the basin as in the 1968 and 1970 floods (G-695 p. 41). Reservoirs meant for irrigation and power generation cannot be depleted on receipt of mere storm warning which cannot give reliable estimate of precipitation on a quantitative basis. If the storm dissipates or contributes less precipitation than estimated, precious water would be wasted resulting in loss of crops and power. Advance releases, however, can be safely made on the basis of actual precipitation in the catchment or actual excess inflow from the upstream reservoir.

(viii) The routed inflow hydrographs at Narmadasagar and Harinphal have been derived by assuming that the contribution from intervening catchment between Bargi and Narmadasagar and between Narmadasagar and Harinphal would be directly the arithmetical difference between the two consecutive peaks without taking into account the effect of time and space. Gujarat pointed out that this approach is neither rational nor correct as the magnitude of flood depends on the pattern of storm location, distance between reservoirs and the travel time of the flood (Gujarat Written Reply 31, page 74).

4. The objections raised by Gujarat to some of the assumptions made in the Monograph, Exhibit MP-515, are valid. It is hence not possible to accept the conclusion in the Monograph that the 1970 flood at Narmadasagar could be moderated to 6.86 lakh cusecs.

STATEMENT 11.1

INFLOW SERIES FOR SARDAR SAROVAR DAM SITE

In Chronological Order

[From Exhibit G-1100(1)]

Sl. No.	Water Year	Inflow (maf)	Sl. No.	Water Year	Inflow (maf)
1	1891–92	54.07	41	1931–32	45.66
2	1892–93	43.08	42	1932–33	35.35
3	1893–94	46.05	43	1933–34	46.34
4	1894–95	44.43	44	1934–35	43.25
5	1895–96	22.58	45	1935–36	31.59
6	1896–97	33.58	46	1936–37	40.87
7	1897–98	28.80	47	1937–38	42.74
8	1898–99	34.64	48	1938–39	41.00
9	1899–1900	4.85	49	1939–40	35.06
10	1900–01	34.03	50	1940–41	37.20
11	1901–02	29.74	51	1941–42	17.88
12	1902–03	19.77	52	1942–43	45.36
13	1903–04	32.48	53	1943–44	41.97
14	1904–05	18.03	54	1944–45	59.10
15	1905–06	27.03	55	1945–46	38.23
16	1906–07	32.85	56	1946–47	44.00
17	1907–08	18.61	57	1947–48	41.30
18	1908–09	31.60	58	1948–49	42.26
19	1909–10	22.24	59	1949–50	33.19
20	1910–11	35.38	60	1950–51	32.43
21	1911–12	22.56	61	1951–52	16.23
22	1912–13	27.05	62	1952–53	21.44
23	1913–14	29.69	63	1953–54	22.92
24	1914–15	30.85	64	1954–55	30.96
25	1915–16	39.37	65	1955–56	40.20
26	1916–17	46.43	66	1956–57	35.17
27	1917–18	48.34	67	1957–58	19.68
28	1918–19	19.58	68	1958–59	27.01
29	1919–20	52.83	69	1959–60	53.05
30	1920–21	21.00	70	1960–61	28.82
31	1921–22	29.97	71	1961–62	60.30
32	1922–23	31.10	72	1962–63	24.78
33	1923–24	43.44	73	1963–64	23.14
34	1924–25	34.90	74	1964–65	27.90
35	1925–26	29.35	75	1965–66	9.92
36	1926–27	46.23	76	1966–67	15.53
37	1927–28	31.68	77	1967–68	30.00
38	1928–29	32.69	78	1968–69	26.71
39	1929–30	31.99	79	1969–70	42.80
40	1930–31	37.11			

NOTE : **The same figures obtain in Exhibit MP-1007-1008 except for Some difference in four years as under :**

Year	G-1100(1)	MP-1007-1008
1958-59	27.01	27.90
1959-60	53.05	53.03
1960-61	28.82	28.87
1965-66	9.92	9.95

STATEMENT 11.1A.

INFLOW SERIES FOR SARDAR SAROVAR DAM SITE

Arranged in Ascending Order

(Prepared from Statement 11.1)

Sl. No.	Water Year	Inflow (maf)	Sl. No.	Water Year	Inflow (maf)
1	1899–1900	4.85	41	1906–07	32.85
2	1965–66	9.92	42	1949–50	33.19
3	1966–67	15.53	43	1896–97	33.58
4	1951–52	16.23	44	1900–01	34.03
5	1941–42	17.88	45	1898–99	34.64
6	1904–05	18.03	46	1924–25	34.90
7	1907–08	18.61	47	1939–40	35.06
8	1918–19	19.58	48	1956–57	35.17
9	1957–58	19.68	49	1932–33	35.35
10	1902–03	19.77	50	1910–11	35.38
11	1920–21	21.00	51	1930–31	37.11
12	1952–53	21.44	52	1940–41	37.20
13	1909–10	22.24	53	1945–46	38.23
14	1911–12	22.56	54	1915–16	39.37
15	1895–96	22.58	55	1955–56	40.20
16	1953–54	22.92	56	1936–37	40.87
17	1963–64	23.14	57	1938–39	41.00
18	1962–63	24.78	58	1947–48	41.30
19	1968–69	26.71	59	1943–44	41.97
20	1958–59*	27.01	60	1948–49	42.26
21	1905–06	27.03	61	1937–38	42.74
22	1912–13	27.05	62	1969–70	42.80
23	1964–65	27.90	63	1892–93	43.08
24	1897–98	28.80	64	1934–35	43.25
25	1960–61	28.82	65	1923–24	43.44
26	1925–26	29.35	66	1946–47	44.00
27	1913–14	29.69	67	1894–95	44.43
28	1901–02	29.74	68	1942–43	45.36
29	1921–22	29.97	69	1931–32	45.66
30	1967–68	30.00	70	1893–94	46.05
31	1914–15	30.85	71	1926–27	46.23
32	1954–55	30.96	72	1933–34	46.34
33	1922–23	31.10	73	1916–17	46.43
34	1935–36	31.59	74	1917–18	48.34
35	1908–09	31.60	75	1919–20	52.83
36	1927–28	31.68	76	1959–60	53.05
37	1929–30	31.99	77	1891–92	54.07
38	1950–51	32.43	78	1944–45	59.10
39	1903–04	32.48	79	1961–62	60.30
40	1928–29	32.69			

*75 per cent dependable inflow

STATEMENT 11.2

INFLOW SERIES FOR NARMADA SAGAR DAM SITE

In Chronological Order

(From Exhibits G-1100 (1) & MP- 1007-1008)

S.No.	Water Year	Inflow (maf)	S.No.	Water Year	Inflow (maf)
1	1891–92	37.97	41	1931–32	35.12
2	1892–93	31.14	42	1932–33	27.18
3	1893–94	34.68	43	1933–34	35.29
4	1894–95	33.67	44	1934–35	35.00
5	1895–96	17.99	45	1935–36	26.85
6	1896–97	27.02	46	1936–37	33.79
7	1897–98	23.09	47	1937–38	35.00
8	1898–99	26.53	48	1938–39	32.95
9	1899–1900	4.46	49	1939–40	29.35
10	1900–01	26.87	50	1940–41	29.34
11	1901–02	24.66	51	1941–42	14.00
12	1902–03	14.66	52	1942–43	35.73
13	1903–04	25.18	53	1943–44	33.82
14	1904–05	13.89	54	1944–45	45.65
15	1905–06	20.18	55	1945–46	30.38
16	1906–07	23.88	56	1946–47	33.55
17	1907–08	15.23	57	1947–48	33.70
18	1908–09	25.69	58	1948–49	33.24
19	1909–10	16.14	59	1949–50	25.68
20	1910–11	26.11	60	1950–51	24.32
21	1911–12	19.84	61	1951–52	12.90
22	1912–13	21.50	62	1952–53	19.32
23	1913–14	21.56	63	1953–54	20.02
24	1914–15	23.53	64	1954–55	22.92
25	1915–16	30.62	65	1955–56	33.49
26	1916–17	35.60	66	1956–57	31.26
27	1917–18	36.77	67	1957–58	16.44
28	1918–19	15.86	68	1958–59	22.73
29	1919–20	40.02	69	1959–60	39.16
30	1920–21	15.29	70	1960–61	24.48
31	1921–22	22.21	71	1961–62	45.96
32	1922–23	23.54	72	1962–63	19.89
33	1923–24	34.01	73	1963–64	20.06
34	1924–25	26.16	74	1964–65	25.19
35	1925–26	23.51	75	1965–66	8.15
36	1926–27	36.75	76	1966–67	12.34
37	1927–28	23.59	77	1967–68	23.09
38	1928–29	24.68	78	1968–69	20.72
39	1929–30	24.87	79	1969–70	30.39
40	1930–31	27.75			

STATEMENT 11.2A

INFLOW SERIES FOR NARMADASAGAR DAM SITE

Arranged in Ascending Order

(Prepared from Statement 11.2)

S.No.	Water Year	Inflow (maf)	S.No.	Water Year	Inflow (maf)
1.	1899-1900	4.46	41	1908–09	25.69
2	1965–66	8.15	42	1910–11	26.11
3	1966–67	12.34	43	1924–25	26.16
4	1951–52	12.90	44	1898–99	26.53
5	1904–05	13.89	45	1935–36	26.85
6	1941–42	14.00	46	1900–01	26.87
7	1902–03	14.66	47	1896–97	27.02
8	1907–08	15.23	48	1932–33	27.18
9	1920–21	15.29	49	1930–31	27.75
10	1918–19	15.86	50	1940–41	29.34
11	1909–10	16.14	51	1939–40	29.35
12	1957–58	16.44	52	1945–46	30.38
13	1895–96	17.99	53	1969–70	30.39
14	1952–53	19.32	54	1915–16	30.62
15	1911–12	19.84	55	1892–93	31.14
16	1962–63	19.89	56	1956–57	31.26
17	1953–54	20.02	57	1938–39	32.95
18	1963–64	20.06	58	1948–49	33.24
19	1905–06	20.18	59	1955–56	33.49
20	1968–69*	20.72	60	1946–47	33.55
21	1912–13	21.50	61	1894–95	33.67
22	1913–14	21.56	62	1947–48	33.70
23	1921–22	22.21	63	1936–37	33.79
24	1958–59	22.73	64	1943–44	33.82
25	1954–55	22.92	65	1923–24	34.01
26	1897–98	23.09	66	1893–94	34.68
27	1967–68	23.09	67	1934–35	35.00
28	1925–26	23.51	68	1937–38	35.00
29	1914–15	23.53	69	1931–32	35.12
30	1922–23	23.54	70	1933–34	35.29
31	1927–28	23.59	71	1916-17	35.60
32	1906–07	23.88	72	1942–43	35.73
33	1950–51	24.32	73	1926–27	36.75
34	1960–61	24.48	74	1917–18	36.77
35	1901–02	24.66	75	1891–92	37.97
36	1928–29	24.68	76	1959–60	39.16
37	1929–30	24.87	77	1919-20	40.02
38	1903–04	25.18	78	1944–45	45.65
39	1964–65	25.19	79	1961–62	45.96
40	1949–50	25.68			

*75 per cent dependable inflow

STATEMENT 11.3

INFLOW SERIES FOR THE CATCHMENT BETWEEN NARMADASAGAR AND SARDAR SAROVAR DAM SITES

In Chronological Order

Derived from Statements 11.1 and 11.2

Sl.No.	Water Year	Inflow (maf)	S.No.	Water Year	Inflow (maf)
1	1891–92	16.10	41	1931–32	10.54
2	1892–93	11.94	42	1932–33	8.17
3	1893–94	11.37	43	1933–34	11.05
4	1894–95	10.76	44	1934–35	8.25
5	1895–96	4.59	45	1935–36	4.74
6	1896–97	6.56	46	1936–37	7.08
7	1897–98	5.71	47	1937–38	7.74
8	1898–99	8.11	48	1938–39	8.05
9	1899–1900	0.39	49	1939–40	5.71
10	1900–01	7.16	50	1940–41	7.86
11	1901–02	5.08	51	1941–42	3.88
12	1902–03	5.11	52	1942–43	9.63
13	1903–04	7.30	53	1943–44	8.15
14	1904–05	4.14	54	1944–45	13.45
15	1905–06	6.85	55	1945–46	7.35
16	1906–07	8.97	56	1946–47	10.45
17	1907–08	3.38	57	1947–48	7.60
18	1908–09	5.91	58	1948–49	9.02
19	1909–10	6.10	59	1949–50	7.51
20	1910–11	9.27	60	1950–51	8.11
21	1911–12	2.72	61	1951–52	3.33
22	1912–13	5.55	62	1952–53	2.12
23	1913–14	8.13	63	1953–54	2.90
24	1914–15	7.32	64	1954–55	8.04
25	1915–16	8.75	65	1955–56	6.71
26	1916–17	10.83	66	1956–57	3.91
27	1917–18	11.57	67	1957–58	3.24
28	1918–19	3.72	68	1958–59	4.28
29	1919–20	12.81	69	1959–60	13.89
30	1920–21	5.71	70	1960–61	4.34
31	1021–22	7.76	71	1961–62	14.34
32	1922–23	7.56	72	1962–63	4.89
33	1923–24	9.43	73	1963–64	3.08
34	1924–25	8.74	74	1964–65	2.71
35	1925–26	5.84	75	1965–66	1.77
36	1926–27	9.48	76	1966–67	3.19
37	1927–28	8.09	77	1967–68	6.91
38	1928–29	8.01	78	1968–69	5.99
39	1929–30	7.12	79	1969–70	12.41
40	1930–31	9.36			

STATEMENT 11.3A

INFLOW SERIES FOR THE CATCHMENT BETWEEN NARMADASAGAR AND SARDAR SAROVAR DAM SITES

In Ascending Order

(Prepared from Statement 11.3)

S. No.	Water Year	Inflow (maf)	S. No.	Water Year	Inflow (maf)
1	1899–1900	0.39	41	1922–23	7.56
2	1965–66	1.77	42	1947–48	7.60
3	1952–53	2.12	43	1937–38	7.74
4	1964–65	2.71	44	1921–22	7.76
5	1911–12	2.72	45	1945–46	7.85
6	1953–54	2.90	46	1940–41	7.86
7	1963–64	3.08	47	1928–29	8.01
8	1966–67	3.19	48	1954–55	8.04
9	1957–58	3.24	49	1938–39	8.05
10	1951–52	3.33	50	1927–28	8.09
11	1907–08	3.38	51	1898–99	8.11
12	1918–19	3.72	52	1950–51	8.11
13	1941–42	3.88	53	1913–14	8.13
14	1956–57	3.91	54	1943–44	8.15
15	1904–05	4.14	55	1932–33	8.17
16	1958–59	4.28	56	1934–35	8.25
17	1960–61	4.34	57	1924–25	8.74
18	1895–96	4.59	58	1915–16	8.75
19	1935–36	4.74	59	1906–07	8.97
20	1962–63	4.89*	60	1948–49	9.02
21	1901–02	5.08	61	1910–11	9.27
22	1902–03	5.11	62	1930–31	9.36
23	1912–13	5.55	63	1923–24	9.43
24	1897–98	5.71	64	1926–27	9.48
25	1939–40	5.71	65	1942–43	9.63
26	1920–21	5.71	66	1946–47	10.45
27	1925–26	5.84	67	1931–32	10.54
28	1908–09	5.91	68	1894–95	10.76
29	1968–69	5.99	69	1916–17	10.83
30	1909–10	6.10	70	1933–34	11.05
31	1896–97	6.56	71	1893–94	11.37
32	1955–56	6.71	72	1917–18	11.57
33	1905–06	6.85	73	1892–93	11.94
34	1967–68	6.91	74	1969–70	12.41
35	1936–37	7.08	75	1919–20	12.81
36	1929–30	7.12	76	1944–45	13.45
37	1900–01	7.16	77	1959–60	13.89
38	1903–04	7.30	78	1961–62	14.34
39	1914–15	7.32	79	1891–92	16.10
40	1949–50	7.51			

*75 per cent dependable inflow.

STATEMENT 11.4

USE BY MADHYA PRADESH ABOVE AND BELOW NARMADASAGAR (FROM MP-1007-1008)

S. No.	Use	Water allocation		Mean of Columns (3+4)	Withdrawal of 18.25
		19.25	17.25		
1	2	3	4	5	6
I.	Requirement of Madhya Pradesh above Narmadasagar				
1.	Irrigation from Major Projects other than Narmadasagar	7.44	6.68	7.06	6.66
2.	Medium & minor schemes	3.93	3.93	3.93	3.93
		11.37	10.61	10.99	10.59
3.	Micro minor/Pumping Schemes	1.98	1.51	1.75	1.65
		13.35	12.12	12.74	12.24
4.	Industrial and domestic	0.98	0.98	0.98	0.98
5.	Narmadasagar	1.23	0.99	1.11	1.05
		15.56	14.09	14.83	14.27
6.	Evaporation loss				
	(1) Excluding Narmadasagar	1.53	1.53	1.53	1.53
	(2) Narmadasagar	0.88	0.88	0.88	0.88
		2.41	2.41	2.41	2.41
7.	Regeneration				
	(1) Irrigation	1.14	1.06	1.10	1.06
	(2) Industrial and domestic	0.49	0.49	0.49	0.49
		1.63	1.55	1.59	1.55
II.	Requirement of Madhya Pradesh below Narmadasagar				
1.	Irrigation from Major Projects	1.82	1.48	1.65	1.56
2.	Medium and minor schemes	1.11	1.11	1.11	1.11
		2.93	2.59	2.76	2.67
3.	Micro minor & pumping schemes	0.94	0.75	0.84	0.79
		3.87	3.34	3.60	3.46
4.	Industrial & domestic	0.52	0.52	0.52	0.52
		4.39	3.86	4.12	3.98
5.	Evaporation loss	4.69	0.67	0.68	0.68
5(a)	Evaporation Excluding Harinphal and Jalsindhi	0.54	0.52	0.53	0.53
6.	Regeneration				
	(1) Irrigation	0.42	0.36	0.39	0.37
	(2) Industrial & domestic	0.21	0.21	0.21	0.21
		0.63	0.57	0.60	0.58
	Total withdrawals above NS	15.56	14.09	14.83	14.27
	Total withdrawals below NS	4.39	3.86	4.12	3.98
	Total withdrawal by MP	19.95	17.95	18.95	18.25

Major = 9.27

Medium 2.41 5.04

MI & P = 2.44

1.5

STATEMENT 11.5

WATER AVAILABLE BELOW MAHESHWAR

Inflow from intermediate catchment (Paragraph 11.2.4)	5.160 MAF
Inflow above Maheshwar (Exhibit MP-326, p.19)	2.200 „
Inflow below Maheshwar	2.960 „

Requirement below Maheshwar

Four Major Projects	0.324 „
Medium, Minor, Micro-Minor & Pumping Schemes : $\frac{1.90 \times 7258}{10,170}$ =	1.356 „
Industrial and domestic use (all assumed above Maheshwar)	Nil
Evaporation loss Medium Minor etc. $\frac{0.21 \times 7258}{10,170}$ =	0.150 „
Evaporation loss in 4 Major Projects (derived from MP-1008 pp. 23 & 28)	0.050 „
Maharashtra use	0.250 „
	2.130 „

Regeneration

(Taken to be 3/4th of 0.37 MAF between Narmadasagar & Sardar Sarovar— See—(Statement 11.4)=	(—)0.278 „
	1.852 „
Available below Maheshwar (2.960—1.852)	1.108 „

The requirement of four major projects below Maheshwar works out to 0.324 MAF as under :—

Requirement of major projects of MP below Narmadasagar	1.56 MAF
Irrigation of the above projects	8.38 lakh acres
Irrigation of Omkareshwar project	6.64 lakh acres
Irrigation of remaining four major projects (8.38—6.64)	1.74 lakh acres
Requirement of four major projects $\frac{1.56 \times 1.74}{8.38}$ =	0.324 MAF

STATEMENT 11.6

TOTAL REQUIREMENT OF WATER FOR PROVIDING 28.0 MAF OF 75 PER CENT DEPENDABILITY TAKING INTO ACCOUNT EVAPORATION LOSSES AND REGENERATION.

(a) Evaporation loss & Regeneration upto Narmadasagar for allocation of 18.25 MAF derived from Exhibit MP-1007 and as worked out in Statement 11.4

	Evaporation	Regeneration from irrigation and industrial and domestic supply.
(i) Medium minor, microminor and pumping schemes	0.415	
(ii) Major Projects (excluding Narmadasagar)	1.115	
(iii) Narmadasagar	0.88	
	2.41	1.06+0.49=1.55

(b) Evaporation loss & regeneration between Narmadasagar and Sardar Sarovar Excluding Harinphal & Jalsindhi derived from Exhibit MP-1019 and as worked out in Statement 11.4

(i) Medium minor, microminor and pumping schemes		0.21	
(ii) Major projects excluding Harinphal and Jalsindhi			
Omkareshwar	0.19		
Maheshwar	0.08	0.32	
4 other projects	0.05		
(iii) Sardar Sarovar		0.50	
Total :		1.03	0.37+0.21+0.02* =0.60
Total (a+b)		3.44	2.15

(iv) For utilising 28 MAF the quantity actually required is 28.00+3.44—2.15=29.29 MAF

*pertains to regeneration from water use in Maharashtra.

STATEMENT 11.7

CARRY OVER REQUIREMENT FOR SECURING 29.29 MAF AT 75 PER CENT DEPENDABILITY

Sl. No.	Water year	Inflow at Sardar Sarovar MAF	Cumulative Shortage
1.	1891-92	54.07	..
2.	1892-93	43.08	..
3.	1893-94	46.05	..
4.	1894-95	44.43	..
5.	1895-96	22.58	6.71*
6.	1896-97	33.58	..
7.	1897-98	28.80	0.49*
8.	1898-99	34.64	..
9.	1899-1900	4.85	24.44
10.	1900-01	34.03	..
11.	1901-02	29.74	..
12.	1902-03	19.77	9.52
13.	1903-04	32.48	..
14.	1904-05	18.03	11.26
15.	1905-06	27.03	13.52
16.	1906-07	32.85	..
17.	1907-08	18.61	10.68
18.	1908-09	31.60	..
19.	1909-10	22.24	7.05
20.	1910-11	35.38	..
21.	1911-12	22.56	6.73
22.	1912-13	27.05	8.97
23.	1913-14	29.69	..
24.	1914-15	30.85	..
25.	1915-16	39.37	..
26.	1916-17	46.43	..
27.	1917-18	48.34	..
28.	1918-19	19.58	9.71
29.	1919-20	52.83	..
30.	1920-21	21.00	8.29*
31.	1921-22	29.97	..
32.	1922-23	31.10	..
33.	1923-24	43.44	..
34.	1924-25	34.90	..
35.	1925-26	29.35	..
36.	1926-27	46.32	..
37.	1927-28	31.68	..
38.	1928-29	32.69	..
39.	1929-30	31.99	..
40.	1930-31	37.11	..
41.	1931-32	45.66	..
42.	1932-33	35.35	..
43.	1933-34	46.34	..
44.	1934-35	43.25	..
45.	1935-36	31.59	..
46.	1936-37	40.87	..
47.	1937-38	42.74	..
48.	1938-39	41.00	..
49.	1939-40	35.06	..
50.	1940-41	37.20	..
51.	1941-42	17.88	11.41
52.	1942-43	45.36	..
53.	1943-44	41.97	..
54.	1944-45	59.10	..
55.	1945-46	38.23	..
56.	1946-47	44.00	..
57.	1947-48	41.30	..
58.	1948-49	42.26	..
59.	1949-50	33.19	..
60.	1950-51	32.43	..
61.	1951-52	16.23	13.06
62.	1952-53	21.44	20.91
63.	1953-54	22.92	27.28
64.	1954-55	30.96	..
65.	1955-56	40.20	..
66.	1956-57	35.17	..
67.	1957-58	19.68	9.61
68.	1958-59	27.01	11.89
69.	1959-60	53.05	..
70.	1960-61	28.82	0.47*
71.	1961-62	60.30	..
72.	1962-63	24.78	4.51*
73.	1963-64	23.14	10.66
74.	1964-65	27.90	12.05
75.	1965-66	9.92	31.42
76.	1966-67	15.53	45.18
77.	1967-68	30.00	..
78.	1968-69	26.71	2.58
79.	1969-70	42.80	..

There are 25 years in which the inflow is less than 29.29 MAF.

In 5 years marked with asterisk the shortage is made up from carry over capacity of 8.29 MAF. Thus a carry-over of 8.29 MAF would be required to achieve 75 per cent dependability.

STATEMENT 11.8

CARRY OVER STORAGE AT AND ABOVE NARMADASAGAR

	MAF For Withdrawal of		
	19.95	17.95	18.25
1. Requirement of non-monsoon period (November to June) (Exhibit MP-809, pp 25, 31)	10.306	9.122	9.356
2. Regulated releases from Narmadasagar (Exhibit MP-1007 pp. 2 & 7)	5.12	6.00	5.736
3. Evaporation loss for non-monsoon period*	1.81	1.81	1.81
4. Total Requirement (1+2+3)			16.902
5. Non-monsoon inflow during the representative year 1958-59 (Exhibit MP-312 Vol. V, p. 97)			2.148
6. Regeneration in non-monsoon period	1.49	1.42	1.455
7. Storage required at and above Narmadasagar at the end of non-monsoon period (4—5—6)			13.299
8. Storage provided	16.83	16.72	16.753
9. Carryover capacity available (8—7)			3.454

*Evaporation loss during the non-monsoon period is taken to be 75 per cent of the annual loss as in MP-158, Vol. 1, p. 39.

STATEMENT 11.

MONTHLY WITHDRAWAL OF WATER FROM SARDAR SAROVAR BY GUJARAT

Figures in MAF

Month	Water requirement for irrigation		Industrial & domestic use	Available from enroute rivers	Net requirement
	As per G-960	For 8.223 MAF use			
1	2	3	4	5	6
July	0.406	0.399	0.088	—	0.487
August	0.591	0.581	0.089	0.094	0.576
September	0.806	0.792	0.090	0.094	0.788
October	0.876	0.861	0.090	0.094	0.857
Sub-Total July to October	2.679	2.633	0.357	0.282	2.708
November	1.062	1.044	0.088	1.122	1.132
December	1.021	1.003	0.087	1.090	1.090
January	0.929	0.913	0.087		1.000
February	0.838	0.822	0.088		0.910
March	0.519	0.510	0.088		0.598
April	0.579	0.569	0.088		0.657
May	0.436	0.428	0.088	0.716	0.516
June	0.306	0.301	0.088		0.389
Sub Total November to June	5.690	5.590	0.702		6.292
Total for the year	8.369	8.223	1.059	0.282	9.000

NOTES : (1) Figures in column 3 are in proportion to use in column 2.

(2) Domestic and industrial water requirements are taken from the chapter on the subject.

(3) Water available from enroute rivers is taken to be as in chapter on the subject and is assumed to be available uniformly in 3 months of August to October.

STATEMENT 11.10

MONTHLY REQUIREMENT OF WATER AT SARDAR SAROVAR

Figures in MAF

Month	Required by Gujarat	Rajasthan	Evaporation loss from Sardar Sarovar	Total required at Sardar Sarovar
1.	2	3	4	5
July	0.487	..	0.03	0.517
August	0.576	..	0.03	0.606
September	0.788	..	0.04	0.828
October	0.857	0.15	0.05	1.057
Sub Total July to October	2.708	0.15	0.15	3.008
November	1.132	0.04	0.04	1.212
December	1.090	0.08	0.03	1.200
January	1.000	0.08	0.03	1.110
February	0.910	0.09	0.03	1.030
March	0.598	0.06	0.04	0.698
April	0.657	..	0.06	0.717
May	0.516	..	0.07	0.586
June	0.389	..	0.05	0.439
Sub Total November to June	6.292	0.35	0.35	6.992
Total for the year	9.00	0.50	0.50	10.00

NOTES : (1) Requirements of Gujarat are as per Statement 11.9.

(2) Rajasthan's requirement has been taken from Exhibit R-267.

STATEMENT II.II

WORKING TABLE OF SARDAR SAROVAR

Month	Storage at start of month	Release from Maheshwar	Net in flow from catchment below Maheshwar	Needs of Sardar Sarovar	Storage at the end of the month
A—Surplus year after a lean year					
July	0.000	0.677	0.017	0.517	0.177
August	0.177	0.677	0.657	0.606	0.905
September	0.905	1.891	1.101	0.828	3.069
October	3.069	1.881	0.306	1.057	4.199
November	4.199	0.677	0.047	1.212	3.711
December	3.711	0.677	0.021	1.200	3.209
January	3.209	0.677	0.018	1.110	2.794
February	2.794	0.677	0.012	1.030	2.453
March	2.453	0.677	0.005	0.698	2.437
April	2.437	0.677	0.001	0.717	2.398
May	2.398	0.677	0.000	0.586	2.489
June	2.489	0.677	0.083	0.439	2.810
TOTAL		10.542	2.268	10.000	
B—Deficit year made successful by use of full carryover					
July	2.810	0.677	0.004	0.517	2.974
August	2.974	0.677	0.129	0.606	3.174
September	3.174	0.677	0.215	0.828	3.238
October	3.238	0.677	0.061	1.057	2.919
November	2.919	0.504	0.009	1.212	2.220
December	2.220	0.504	0.005	1.200	1.529
January	1.529	0.504	0.005	1.110	0.928
February	0.928	0.504	0.002	1.030	0.404
March	0.404	0.504	0.000	0.698	0.210
April	0.210	0.507	0.000	0.717	0.000
May	0.000	0.586	0.000	0.586	0.000
June	0.000	0.421	0.018	0.439	0.000
TOTAL		6.742	0.448	10.000	

In preparing the working table, a surplus year has been assumed to commence with empty reservoirs. During the year, the full carryover storage of 2.81 MAF at Sardar Sarovar is secured. This surplus year is assumed to be followed by a lean year in which the carryover storage is fully utilised leaving the reservoirs empty. These conditions give the maximum requirement of space for regulation cum carryover which comes to 4.20 MAF. In a surplus water year in the first two months releases are made on the basis of the year being a normal 75 per cent dependable year as it is only in September that it becomes evident that the year is a surplus one. Likewise, in a lean water year, normal releases are made in the first four months and reduced releases are made from November onwards on knowing the extent of deficit in the year. In the last three months of the deficit year, the releases are made to match requirement as there is no storage left in the reservoir for any re-regulation.

CHAPTER XII

GEOLOGICAL AND SEISMOLOGICAL ASPECTS OF SARDAR SAROVAR DAM SITE

Geological Aspect

12.1.1 Madhya Pradesh and Maharashtra have disputed the suitability of the proposed dam site on geological and seismological considerations. Gujarat, however, has refuted the objections. The Sardar Sarovar Project Report (1971), Ex G-177, contains a report in four volumes on the geological aspects of the dam site, based on field investigations carried out by the Geological Survey of India (GSI) during 1963-64 to 1967-68 field seasons. Three sites, named Site 1, Site 2 and Site 3 were explored. Site 2 which is 1-1/2 miles upstream of Site 1 was preferred to the latter to avoid deep excavation and to take advantage of its shorter length. Geological investigations, however, revealed the existence of two faults there, one along the river channel in an almost East-West direction and the other running on the right bank N 65°E-S 65°W. The two faults thus converge in the downstream direction. The block between them is lifted resulting in a horst. The two faults are considered to be inactive or dead. By shifting the alignment 2000 feet further upstream to Site 3, which is even shorter in length, the right bank fault is avoided as it gets well beyond the right abutment of the dam. Gujarat proposes to build its high dam at this site on a reoriented alignment of the axis.

12.1.2 The proposed dam site is situated on the Deccan Trap basalt of Cretaceo—Eocene period which overlies the Bagh sedimentary bed of Cretaceous age (62 to 130 million years before the present). The Bagh beds comprise sandstones, quartzites, limestone and shales, and form inliers in the Deccan trap. In the proximity of the dam site, these are exposed at Mokhadi about 1/4 of a mile upstream of Site 3 and near Limdi 2-3/4 miles downstream of it. The region is traversed by a swarm of dolerite dykes, with trend varying from East-West to NE-SW direction. These pertain to Eocene period (about 50 million years before the present). Their width vary and go upto 195 feet. The right hand side of the dam would abut against one such dyke. There is a bed of red bole of 0.15 to 0.61 m thickness around RL 74 between chainage 4100 ft. and 4335 ft. The foundation is proposed to be taken below this bed. Apart from the major river channel fault, there are a few minor faults and shear planes in the vicinity of the dam site. These have not been considered as significant to the proposed dam and the appurtenant structures. Percolation tests made in the drill holes have indicated the need of extensive consolidation grouting as the leakage has been found to be well over one lugeon.

12.1.3 The river channel fault is a reverse one with a throwdown of 173 metres (570 feet). It dips at an angle of about 60 degrees towards the right bank. It has no clay gouge. The fault zone has been proposed to be treated by excavating the fractured and weathered overlying rock and backfilling with concrete to the minimum necessary depth. Grouting of the foundation has also been propopsed.

12.1.4 Apart from the investigations made by the Geological Survey of India, the contending States obtained geological reports on the dam site from their own experts. Madhya Pradesh has exhibited a report dated January 1976, (MP-789) from Dr. S. N. Pandey of University of Sagar based on Earth Resources Technology Satellite imagery and another one from Shri K. N. Das et al (Ex MP-839) of the same University. Maharashtra has filed a report (MR-139) prepared by Dr. R. B. Gupte of College of Engineering, Pune, in 1975 and another report (Ex MP-149) prepared by him in 1977. Gujarat has exhibited a report dated December 1976, from Dr. Jai Krishna et al of University of Roorkee (G-1073). Shri J. P. Srivastava, Director, G.S.I. has given his comments on the report of Shri K. N. Das et al in the later part of 1976 (G-1061). Besides these a number of reports and documents by other scientists having a bearing on the geology and seismology of the region have been produced in evidence.

Contentions of Madhya Pradesh

12.2.1 Basing itself on the reports of Shri K. N. Das et al and Dr. S. N. Pandey, Madhya Pradesh has taken the extreme view that the site proposed for Sardar Sarovar dam is geologically and seismologically unsuitable not only for a high dam but for the construction of any dam there.* Among the reasons advanced by it for taking this view, the important ones stated are the following :—

(i) The foundation rocks consisting of Bagh formation and basaltic rocks of deccan trap have been subjected to repeated tectonic events and have lost much of their bearing strength.

(ii) The fault, shear, fractured and open jointed zones and bedding planes dip at low angles towards downstream giving rise to sliding and slippage structures within the foundation. Further the upthrown block between the river bed fault and right bank fault tapers towards downstream side with Mokhadi fault upstream of the site cutting across both of them. On construction of the dam, this horst block would slide downward due to water pressure.

*Page 1 of Volume XII of Written Submission of Madhya Pradesh.

(iii) Due to numerous opening in joints, shear zones, fractures, lava interflow zones, which grouting cannot seal, the foundation cannot be made watertight. Furthermore, the extent of cavernous openings in the Bagh formations is not known.

(iv) The Bagh formations have suffered from different erosion cycles prior to the coming in of the lava flows which cap the Bagh formations. The basaltic rock formations of lava flows have suffered from interflow weathering due to the time gap between successive flow eruptions. Heavy water loss during pressure tests shows the unsoundness of the rock foundation. Also since Gujarat has not carried out the experimsnts recommended by GSI to prove that satisfactory grouting of foundation at the site would be practicable, the suitability of foundation has not been established.

(v) The dam site and its environs lie in a highly seismic area. The faults found in and around the site are very much active and if triggering action is provided they will give rise to earthquakes.

Averment of Maharashtra

12.3.1 Relying upon Dr. Gupte's Report, Maharashtra has taken the stand that it is undesirable, though not impossible, to build a high dam at Navagam at Site 3 because of the prohibitive cost of treatment of adverse geological features. Maharashtra has stated that there are crushed and fragmented rocks at the site as also cavernous limestones. The river channel fault will require special treatment. Also, as no grouting experiments have been carried out the groutability of the fault zone is very much in doubt. Dr. Gupte has indicated an excessive amount of Rs. 73.25 crores as the likely cost of foundation treatment over and above the normal expenditure on such works. In the revised Sardar Sarovar Project estimate (1975-76 rates), the cost of treatment indicated by Gujarat is Rs. 6.62 crores which may prove to be somewhat on the low side.

Gujarat's Rejoinder

12.4.1 Gujarat has submitted that according to the tests carried out by it, the foundation rock has been found to have a bearing strength many times the load that would be imposed by the high dam. It has stated that there is no apprehension of sliding of foundation rock and has quoted the view of Dr. Jai Krishna et al (G-1073) that the Deccan Trap flows resting over the undulating Bagh bed formation would provide tremendous shear friction against sliding. The network of dolerite dykes would provide further stability to the dam foundation. Gujarat has contested the assumption of intersection of the river channel fault and the old river fault and has denied the existence of Mokhadi fault which Dr. Jai Krishna et al considers as only unconformity. Gujarat has pointed out that no cavities or openings were observed in the basalt and sedimentary rocks during investigation and there is no mention of these in the GSI reports. Any cavities or holes that might have been there in the Bagh beds must have got filled up with the coming in of lave inflows which cap the sedimentaries. The actual delineation of joints, fractures, shear zones will be done in design stage studies by excavating trenches. Treatment of shear zones in foundation is very common and has been done at many dams in India and abroad. Gujarat referred the adverse observations of Shri K. N. Das and others to Shri J. P. Srivastava, Director, Engineering Geology Division, GSI, Western Region for his comments. Shri Srivastava has refuted their contentions (in Ex G-1061) and has upheld the findings of the investigating geologists.

Seismic Considerations

12.5.1 The Broach earthquake of March 23, 1970 drew pointed attention to the seismicity of the region. Madhya Pradesh has pointed out that the proposed dam site lies in the heart of a rectonically active zone. Quoting Balasundaram et al, it has stated that the Broach earthquake is attributed to movements along the Narmada fault line discovered by the ONGC. Moreover, the Narmada fault runs close to the dam site. On the other hand, Dr. Jai Krishna et al have stated that the Narmada fault in Broach region is a feature within the Cambay Basin and does not extend east of Rajpardi fault, located 55 km west of the dam site. The minor river channel on echelon faults and shear zones near the dam site, are local features and have no regional manifestations. Gujarat has stated that the dam site lies in seismic Zone III and that the intensity of the Broach earthquake in its vicinity was Modified Merceclli intensity IV and no damage was noticed there. Dr. Jai Krishna et al have pointed out that Bhakra dam lies in Seismic Zone IV and that the great Kangra earthquake of 1905 with a magnitude of 8.6 had its epicentre 80 km northwest of Bhakra dam site, whereas the 1970 Broach earthquake of magnitude of 5.4 had its epicentre at a distance of over 80 km southwest of the proposed dam site. They have expressed the definite view that a high concrete gravity dam can be safely constructed at the proposed site taking into account the earthquake forces due to a probable medium size earthquake that may occur in the surrounding region.

12.5.2 On a reference from Gujarat the Standing Committee under the Central Water and Power Commission for recommending seismic co-efficients for design of structures for river valley projects has advised the adoption of a co-efficient of 0.10 g for designing the dam (G-627, P. 93). It was suggested by Counsel for Madhya Pradesh that the Committee was not seized of the full facts regarding Broach earthquake in making the recommendation, implying thereby that a higher co-efficient was called for. In our view, there is no substance in this argument. Gujarat has produced evidence to show that the Committee had considered all relevant material about the Broach earthquake*. The co-efficient recommended by the Committee appears in our view to be adequate as the same was adopted in the design of Bhakra dam located in an area of greater seismicity.

*See proceedings of the Standing Committee Ex G-1036. The Chairman of the Committee was Shri Y.K. Murthy (Member D & R), CWPC and one of the Committee Members was Shri V.Prasad, Officer-in-Charge, GSI Western Region, Jaipur.

Comments of Shri Srivastava, GSI

12.6.1 As a prelude to his comments on the report of Shri K. N. Das and others of Sagar University, Shri J. P. Srivastava, Director, Engineering Geology Division, GSI, Western Region, has quoted Mr. Edward B. Burwell regarding the qualifications of an Engineering Geologist as under :—

> "He should not be an alarmist. Neither faults, nor earthquakes, nor cavernous limestones, nor low water tables should deter him from rationalising the field evidences and proceeding to logical conclusions based on due consideration of both facts and inferences. Many effective dams have been built on cavernous limestones. Many safe dams have been constructed on faults in regions of crustal instability."

Shri Srivastava has stated that "the river valley Project being a multi-disciplinary venture, it is not the role of an engineering geologist to finally approve or reject a site. His job is to identify the regional and local geological setting and diagnose the adverse foundation features of a site and help the engineers to evolve a suitable design and remedial measures and it is for the engineer to finally select a site and build the dam".

12.6.2 Refuting the contentions of Shri K. N. Das and others, Shri Srivastava has observed that "generally consultant committees made up of eminent engineers and experienced geologists critically examine the data, get further experiments and explorations done, if necessary, weigh different possibilities, work comparative economics of various alternative solutions and then come to a final method of treatment to be given to a particular feature, such as river channel faults. All this exercise is done at the construction stage". Commenting on the seismicity of the site he has stated that "many high dams have been constructed in seismically active areas. Therefore, it stands to sound reason that dam can be constructed at Navagam also with proper safety factors". He has added that "at the feasibility stage investigations, no such harmful features have been found by the investigating geologists which render the site unsuitable".

Conclusion

12.7.1 Considering that the Geological Survey of India is the official agency which is entrusted with all geological investigations of major river valley projects and all such projects are planned on the basis of its findings, we accept the views of Shri Srivastava in the present case regarding the feasibility of the Navagam Site 3 for constructing a high dam there. The decision on the treatment of the various adverse features met in the dam foundation will be taken at the proper stage by the consulting committee of engineers and geologists referred to by Shri Srivastava. (See page 25, Ex. G-1061).

Advice of the Assessors

12.8.1 We have consulted our Technical Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this chapter. They have advised us that they all agree with the conclusion reached in paragraph 12.7.1 and also the reasoning given by us in the previous paragraphs.

CHAPTER XIII

HEIGHT OF NAVAGAM DAM—EXAMINATION OF THE ALTERNATIVE PROPOSALS OF MADHYA PRADESH AND MAHARASHTRA

*The Proposals**

13.1.1 Gujarat has proposed to build Sardar Sarovar dam with full reservoir level (FRL) +530 and maximum water level (MWL) +540 at Navagam at re-oriented Site 3, with Navagam Canal taking off with full supply level (FSL) +300 at its head regulator. Madhya Pradesh has proposed to construct on the main stem of the river below Narmada Sagar three dams at Omkareshwar, Maheshwar and Harinphal and in addition, jointly with Maharashtra, a dam at Jalsindhi. The Omkareshwar project, January 1972 (Exhibit MP-323), stipulates a FRL of +660 and tail race level (TRL) +534. The latest Maheshwar project, January 1972 (Exhibit MP-326), envisages a FRL+534 and TRL+457. The scope of Harinphal project has been changing as below :—

Date of Project Report	Exhibit No.	FRL	TRL Minimum
1965 . . .	MP-322	460	320
Jan. 1972	MP-327	455	355
Jan. 1975	MP-527	420	355

The July 1970 project report of Jalsindhi project (Exhibit MR-37) showed a FRL+355 and TRL+210. In January 1977, Madhya Pradesh and Maharashtra jointly roposed the revised Jalsindhi project with FRL+420 and normal TRL+210 (Exhibit MR-137). With this proposal the Harinphal project was abandoned in its favour. Madhya Pradesh and Maharashtra have contended that Sardar Sarovar should be restricted to FRL+210 with Navagam Canal taking off with FSL+190.

13.1.2 The Onkareshwar project caters both for power generation and irrigation. But its live storage capacity of 0.650 MAF is insufficient for its requirement of irrigation for meeting which releases have to be made from Narmada Sagar. The Maheshwar Project is purely a power project and caters for no other purose. It has a lift dam with no live storage capacity in the reservoir beyond that required for diurnal and weekly variation in power generation. The revised Jalsindhi project (1977) is also a power project and is intended to serve no other purpose. The low Sardar Sarovar dam with FRL+210 is only a diversion structure for diverting supplies into Navagam Canal. The proposals of Madhya Pradesh and Maharashtra envisage that the entire requirement of Navagam Canal for Gujarat and Rajasthan would be met by releases from Narmada Sagar, excepting what can be utilised out of the inflows from the catchment area below it.

Sardar Sarovar FRL+455

13.1.3 For reasons discussed earlier in Chapter XI, the FRL of Sardar Sarovar has been fixed at +455 and MWL at +460. The Navagam Canal is required to take off with FSL+300 at its head regulator. Sardar Sarovar provides for a gross storage capacity of 7.70 MAF at FRL+455, as under :—

	MAF
(i) Dead storage (MDDL + 363) . . .	2.97
(ii) Live storage foreregulation and carry-over .	4.20
(iii) Silt reserve in live storage	0.30
(iv) Capacity for utilisation to a certain extent surplus supplies from the catchment area below Narmadasagar when available. . .	0.23
TOTAL .	7.70

It is stipulated that supplemental uniform releases would be made by Madhya Pradesh to the extent necessary to meet the full requirements of Navagam Canal of 9.0 MAF for Gujarat and 0.5 MAF for Rajasthan of 75 per cent dependability.

Consideration of Relative Merits

13.2.1 The merits and demerits of Sardar Sarovar with FRL+455 may be compared with that of the proposal of Madhya Pradesh and Maharashtra for Jalsindhi dam FRL+420 and Sardar Sarovar dam FRL+210. The points for consideration would be :—

(i) Submergence of areas ;

(ii) Storage capacity, dead, live and carry-over;

(iii) Facility for regulating supplies for Navagam Canal ;

(iv) Irrigation benefits ; and

(v) Power benefits.

*Throughout this chapter, Sardar Sarovar with FRL+455 is called high Sardar Sarovar, Jalsindhi project with FRL+420 as Jalsindhi and Sardar Sarovar with FRL+210 as low Sardar Sarovar though technically a dam of that height would be classed as a high dam.

**For the purpose of comparison, the regulated discharge passing into Navagam Canal is taken as 9.5 MAF per year althogh the Jalsindhi (1977) and Sardar Sarovar Project Reports have assumed different figures.

Submergence

13.2.2 A flood lift of five feet is stipulated for Sardar Sarovar FRL+455 which brings its MWL to +460. The Jalsindhi Project (1977) makes a similar provision and sets the MWL at +425. The flood lift in the case of low Sardar Sarovar, FRL +210, would have to be substantially more because the submergence would be confined to the river channel. Allowing a flood lift of ten feet there, the MWL would be +220. It is assumed that land in each case will be acquired upto FRL.

13.2.3 It is stated at page 93 of Volume I of the Jalsindhi Project Report (1977) that detailed property survey of the area that would be submerged in Madhya Pradesh at FRL+420 and MWL+425 has been done by that Government. According to these surveys the sub-merged area at FRL+420 would be as under :

Culturable area	3,328 acres
Forest land	1,939 acres
Unculturable area . . .	18,686 acres
	24,253 acres

It is further stated in the project report that the area submerged in Maharashtra would be 4,747 acres of mostly forest land. Thus, the total submergence by Jalsindhi reservoir at FRL +420 would be 29,000 acres, estimated to cost Rs. 472 lakhs vide page 78 of Volume II of the Project Report.

The area submerged under Sardar Sarovar at FRL +210 would be 7550 acres consisting mainly of unculturable land in Gujarat and land classified as forest area in Maharashtra, the cultivable area being 300 acres vide Exhibit MP-902. Only a small portion of about 200 acres of unculturable land would lie in Madhya Pradesh.

Against the total submergence of 36,550 acres (29,000 + 7,550) by Jalsindhi at +420 and Sardar Sarovar at +210, the total submergence by Sardar Sarovar at RL +455 would be 91,500 acres of which 30,000 acres are cultivable. It is thus evident that considerably more area would be submerged by the high Sardar Sarovar than by the low Sardar Sarovar and Jalsindhi together.

gross storage capacity of 0.42 MAF at FRI

Storage capacity

13.2.4 The low Sardar Sarovar dam has a gross storage capacity of 0.42 MAF at FRL +210. The difference of 20 feet between FRL +210 and FSL +190 of the canal, having a capacity of only 0.11 MAF, is intended to meet primarily the requirement of cut-off and variation in power generation. The reservoir has hardly any storage to cope with the varying demands of Navagam Canal with uniform releases from Narmada Sagar. Nor has it any carry-over capacity for storing surplus inflows or for combing inflows from the catchment area between Narmada Sagar and Sardar Sarovar. The Jalsindhi dam site is 34 miles (54 km) upstream of Sardar Sarovar dam site and the catchment area between the two is 520 sq. miles. Narmada Sagar is 198 miles (317 km) upstream of Sardar Sarovar dam site and the catchment area between the two is 10,170 sq. miles. The 75 per cent dependable inflow from this catchment, as worked out in Chapter XI, Paragraph 11.2.4 is 5.16 MAF. *Pro rata,* the inflow of 75 per cent dependability from the catchment area below Jalsindhi would be 0.26 MAF. As most of it would come in large volume during heavy rainfall, it would not be possible to utilise it in Navagam Canal to any significant extent. Most of this inflow would, therefore, be wasted down to the sea. Also all inflows in excess of the 75 per cent dependable inflow would go down to the sea.

13.2.5 The gross storage capacity of Jalsindhi reservoir at FRL +420 is 1.60 MAF. A live storage capacity of 1.209 MAF is shown in the project report with MDDL at +339. However, while calculating power availability from the project an MDDL of +400 has been assumed *vide* Exhibit MR-137 Vol. II p. 38. The live capacity betwen RL +420 and RL +400 is 0.432 MAF, part of which would be required for diurnal and weekly variations in power generation, leaving a marginal capacity for regulation of the canal. Operating the reservoir with MDDL +400, there would be hardly any capacity for storing inflows of 75 per cent dependability from the catchment area below Narmadasagar or for carry-over from surplus years. In Chapter XI, Paragraph 11.6.2, a silt storage capacity of 1.0 MAF has been assumed for Sardar Sarovar with FRL +455. The requirement of silt storage for Jalsindhi FRL +420 would be somewhat less, say, 0.9 MAF. When the reservoir silts upto that extent, it would leave a capacity of only 0.7 MAF for live storage. Therefore, if the reservoir is operated with this live storage capacity, the capacity would be quite inadequate, as paragraph 13.1.3 *supra* would indicate.

13.2.6 The High Sardar Sarovar will have the sill of canal inlets at about RL +285. It would take over 300 years for the reservoir to silt up to that level. In contrast the Jalsindhi reservoir would silt upto penstock level RL +300 in about 100 years. Thus, from consideration of siltation of the reservoir, the high Sardar Sarovar has an advantage over the Jalsindhi reservoir. The high Sardar Sarovar makes adequate provision for silt reserve in live storage, for storing and regulating supplies of 75 per cent dependability and for utilisation of excess inflows of surplus years to some extent. Above all it allows the least amount of water going waste to the sea in the final stage of development.

Regulation of Supplies for Navagam Canal

13.2.7 As would be seen from Statement 11.9 of Chapter XI, the water requirements of Navagam Canal varies from 1.132 MAF in November to 0.389 MAF in June. The inflows from the catchment below Narmada Sagar, excluding the utilisation by Maharashtra, range between 2.00 MAF in September and nil during April and May. Thus, with uniform releases from Madhya Pradesh, a good deal of regulation becomes necessary at Sardar Sarovar in order to run the Navagam Canal with the required discharge. The low Sardar Sarovar has no capacity for such regulation. The next point at which supplies can be regulated, though not satisfactorily, is Jalsindhi dam of Madhya Pradesh and Maharashtra, 34 miles upstream of Sardar Sarovar dam. Even Jalsindhi reservoir does not have the capacity for month to month regulation. Also, it is administratively unsuitable and in practice unsatisfactory to

regulate supplies for Gujarat at a far away regulating point in Madhya Pradesh and Maharashtra. It would be worse if regulation is attempted at Narmada Sagar 198 miles upstream. Moreover, on reducing supplies at the canal head in the event of sudden drop in demand in the canal due to whether conditions or accident, water would go down to the sea as low Sardar Sarovar will not be able to store it for lack of storage capacity. The high Sardar Sarovar, on the other hand, would provide full facility for regulation of Navagam canal and avoid any waste due to such emergencies.

Irrigation Benefiits

13.3.1 Sardar Sarovar FRL+210, with its disabilities discussed above, would supply water into Navagam Canal only at FSL+190. Maharashtra had proposed before the Khosla Committee a canal taking off with FSL +190 and a gradient of 1 in 12,500. It has since reviewed this particular proposal and according to its revised version, it can serve in the zoned areas of Gujarat 25.60 lakh acres by flow and 10.70 lakh acres by lift, a total of 36.30 lakh acres. This canal, according to Maharashtra, would reach Rajasthan border at RL +38.0, *vide* Exhibit MR-148. Rajasthan has contended that the canal would actually reach its border at an appreciably lower level. In either case, the irrigation in Rajasthan, with this gradient of the canal, would be entirely by lift. Maharashtra, however, does not favour this scheme any longer. It has now proposed a canal taking off with FSL +190 and a gradient of 1 in 20,000 and calls it as its basic scheme. But the flatter the gradient, the lower is the velocity of flow. Therefore, it would require a larger cross-section of the canal and cost more. According to this basic scheme, a CCA of 32.27 lakh acres can be served by flow and 10.70 lakh acres by lift, a total of 42.97 lakh acres in the zoned areas of Gujarat. The scheme does not provide for any irrigation in the area between +300 FSL canal and +190 FSL canal. This area can, however, be served by lift on water being made available for it. According to Maharashtra, the canal with a gradient of 1 in 20,000 would reach Rajasthan border at RL +63, *vide* Exhibit MR-142. With that level, the entire irrigation in Rajasthan can only be by lift.

13.3.2 As contemplated under the high Sardar Sarovar Scheme, the Navagam Canal is required to take off from the high Sardar Sarovar reservoir with FSL +300 at its head regulator and a gradient of 1 in 12,000 upto Saurashtra branch and 1 in 10,000 thereafter, reaching Rajasthan border at RL 131. This would enable it to serve in the zoned area of Gujarat, a CCA of approximately 52.99 lakh acres by flow and 3.93 lakh acres by lift, a total of 56.92 lakh acres. Also most of the CCA in Rajasthan would be served by flow. Maharashtra, however, has contended that in crossing the Saurashtra and Banni depression, water has first to be dropped and then lifted after crossing the depression and the area beyond the depression should, therefore, be treated as lift area. In that case, the CCA served by flow in the zoned areas of Gujarat, would be reduced to 46.22 lakh acres and that by lift increased to 10.70 lakh acres, the total remaining 56.92 lakh acres. The point is, however, debatable as the dropping water would generate power which would be used for lifting water again with some supplemental power. It is evident that from the point of view of irrigation benefits, the +300 FSL canal taking off from high Sardar Sarovar would be better than the +190 canal.

Power Benefits

13.4.1 In the case of Sardar Sarovar with FRL+210, serving only as a diversion structure for the canal with FSL+190, it is unlikely that power would be generated at canal head. Maharashtra has recognised that in actual practice it would not be possible to generate power when the average head is less than 15 feet, *vide* Maharashtra Note 38, page 51. There can be a river bed power house for generation of power with the water let down into the river. With a TRL of +85 it will have an effective head of 119 feet. At Jalsindhi with the reservoir operating between FRL +420 and MDDL +339 and TRL +210, the effective head would be 183 feet. On full development of irrigation, in a year of 75 per cent dependability the flow there would be about 9.68 MAF, which would generate 1531 MKWH in the year, *vide* Statement 13.1. In the case of Sardar Sarovar FRL +455 and the canal with FSL +300, there would be a canal power house and a river bed power house. The MDDL in either case would be +363. Calculations of power generation are given in Statement 13.2. The effective head at the canal power house would be 117 feet and that at the river bed power house 339 feet. In a year of 75 per cent dependability, with 9.5 MAF let into the canal 960 MKWH would be generated at the canal power house.

13.4.2 During the period of development of irrigation, there would be considerable inflow in excess of requirement in most years. The surplus would, however, progressively decrease as development proceeds. Yet, even on full development there would be a surplus of varying magnitude in about 50 per cent years. This could be used for generating power at Jalsindhi and river bed power house of Sardar Sarovar. The total effective head available with Jalsindhi and low Sardar Sarovar would be 302 feet (183+119), while with high Sardar Sarovar it would be 339 feet. Moreover, on full development of irrigation, the surplus inflows would be greater at high Sardar Sarovar than at Jalsindhi because of the contribution from the catchment area below Jalsindhi. Therefore, both on account of greater effective head and larger surplus inflows it would be possible to generate more power with high Sardar Sarovar than with Jalsindhi and low Sardar Sarovar.

13.4.3 On full development of irrigation, in a year of 75 per cent dependability, power generation would be 1531 MKWH in the case of Jalsindhi and low Sardar Sarovar and 960 MKWH in the case of high Sardar Sarovar. The higher generation in the Jalsindhi-cum-low Sardar Sarovar is mainly due to the canal being considered at FSL +190 as against +300 in the case of Sardar Sarovar. It is to be noted that in the case of Jalsindhi-cum-low Sardar Sarovar extra regulated releases of more than 1 MAF would be necessary from Narmadasagar. In the early stages of irrigation development, the power developed at Sardar Sarovar will be more than that at Jalsindhi, *vide* Statement 13.3.

Reasons for and against the alternative schemes

13.5.1 The Jalsindhi reservoir and low Sardar Sarovar together would submerge 36,550 acres of land including about 3,600 acres of culturable area. Against this, high Sardar Sarovar would submerge 91,500 acres of land including about 30,000 acres of culturable area. Jalsindhi and low Sardar Sarovar would produce 571 MKWH more power than high Sardar Sarovar on full development of irrigation. From consideration of submergence and power generation, therefore, Jalsindhi and low Sardar Sarovar are attractive but are otherwise disadvantageous in several respects. Both the reservoirs have inadequate capacity. Because of it, bulk of the inflows of 0.26 MAF of 75 per cent dependability from the catchment area below Jalsindhi and all the excess inflows of surplus years from the entire catchment below Narmada Sagar would go waste to the sea. This would necessitate extra regulated releases of more than one MAF from Narmada Sagar. With Jalsindhi and low Sardar Sarovar, the regulation of Navagam Canal will have to be done, with unacceptably varying releases at distant Narmada Sagar or Jalsindhi outside Gujarat territory which is an unsatisfactory arrangement. Moreover, on sudden reduction of supplies in the canal due to weather conditions or accident, some water would be wasted to the sea as it cannot be stored for subsequent use. The low Sardar Sarovar admits of taking off the Navagam Canal with FSL+190 only. At that level, the canal, even with an unacceptable gradient of 1 in 20,000, can serve in the zoned area of Gujarat, a CCA of 32.27 lakh acres by flow and 10.70 lakh acres by lift. The irrigation in Rajasthan would be only by lift. In contrast, the canal from the high Sardar Sarovar would take off with FSL+300 and serve in the zoned areas of Gujarat, even on Maharashtra's debatable interpretation of lift, at least a CCA of 46.22 lakh acres by flow and 10.70 lakh acres by lift. Moreover, irrigation in Rajasthan in this case would be mostly by flow. The difference in the flow command in the two alternatives is 13.95 lakh acres (46.22-32.27). Also, 10.70 lakh acres of lift area would have 110 feet (300-190) more lift in the case of Jalsindhi-cum-low Sardar Sarovar. If these differences are sought to be made up by lifting water, it would require 586 MKWH for pumping *vide* Statement 13.4. as against 571 MKWH (1531-960) which Jalsindhi would produce, apart from other demerits of this arrangement.

13.5.2. The water resources of the Narmada have to be utilised in a manner that would ensure the least wastage of water to the sea. Also, irrigation should be done by flow to the maximum extent feasible, as lift irrigation is expensive and imposes a perpetual burden on the irrigators. In our opinion, the interest of irrigation should receive preference over that of power generation in the circumstances of the present case. Discussing the choice between the use of water for irrigation and power generation, the Irrigation Commission, 1972 in its Report Vol. I page 90, observed that "the priority has to be determined not only by economic considerations but by recognition of the fact that irrigation is possible only by the use of water, whereas power can be generated from alternative sources such as coal, gas, oil and atomic fuels." The Commission pointed out that "the United States Bureau of Reclamation considers irrigation of paramount importance in the planning of multi-purpose projects, and nowhere in its policy-making legislation does the Bureau accord recognition to power production as a function superior to the use of water for irrigation."[1] The Jalsindhi with low Sardar Sarovar gives Madhya Pradesh and Maharashtra the benefit of power generation but by sacrificing the irrigation interest of Gujarat and wasting to sea appreciable water resources of the river. The high Sardar Sarovar, with a gross storage capacity of 7.7 MAF, no doubt submerges a lot more area than Jalsindhi and low Sardar Sarovar but the submergence is less than even half of that by Narmada Sagar with its gross storage capacity of 9.9 MAF. Nor is the submergence by high Sardar Sarovar excessive in relation to its capacity when compared with a number of other projects, *vide* Table GT-17 at page 112 of Volume I of the Statement of Case of Gujarat. In the light of what has been stated above, it is obvious that high Sardar Sarovar should be preferred to Jalsindhi-cum-low Sardar Sarovar.

*Jalsindhi FRL+*DEE *and Reduced Sardar Sarovar*

13.6.1. It can be argued that if submergence to RL+455 is to be countenanced for high Sardar Sarovar, then Madhya Pradesh and Maharashtra might be permitted to construct Jalsindhi dam with FRL+455 and MWL +460, restricting Sardar Sarovar to a level which would suffice for satisfactorily feeding the Navagam Canal with FSL +300. This argument cannot be accepted for the following reasons :

13.6.2. For diverting supplies into Navagam Canal with FSL +300 an FRL of +307 would be required at Sardar Sarovar, allowing 2 feet loss of head at the regulator and 5 feet driving head to the head-ponds. With this level its capacity would be 1.68 MAF which would suffice for silt storage in the reservoir. A further space of two feet would, however, be required to even out flows from tail race of Jalsindhi power house. In paragraph 13.1.3 supra, it has been indicated that in high Sardar Sarovar a live storage capacity of 4.20 MAF would be required. The live storage capacity is required for providing regulated supplies from the reservoir to Navagam Canal and the carry-over capacity to ensure the utilisable quantum of 28 MAF after making allowance for evaporation and regeneration.

13.6.3. As regards Jalsindhi reservoir, its capacity at FRL +455 would be 2.915 MAF. Providing 0.9 MAF for silt deposition, it would have a live storage capacity of 2.015 MAF. Against the total capacity of 4.20 MAF required for regulating supplies and carry-over, the live storage capacity available at Jalsindhi would be only 2.015 MAF. It is thus obvious that with uniform releases from Narmada Sagar, the Jalsindhi reservoir with FRL +455 cannot meet the monthly regulation requirements for Navagam Canal nor provide any carry-over capacity for utilising excess inflows in surplus years which would, therefore, go waste to the sea. The unsuitability of varying releases from Narmada Sagar from month to month requiring less capacity at Sardar Sarovar has already been pointed out in Chapter XI on the height of Sardar Sarovar Dam.

[1] The Krishna Tribunal has also taken the same view and states that irrigation use of waters of River Krishna must prevail over the hydro-electric use *vide* page 475, Vol. II of its Report (1973).

13.6.4. With Jalsindhi FRL+455 and Sardar Sarovar FRL +309 less power would be generated than with Jalsindhi FRL +420 and Sardar Sarovar FRL +210 earlier considered because the effective head would be less. On full development of irrigation the outflow of 75 per cent dependability at Jalsindhi would be 9.68 MAF. This would produce 960 MKWH of power there with FRL+455, *vide* Statement 13.5. Some additional power generation would be possible there with the excess inflows of surplus years on a few days in the flood season limited by available plant capacity. Similarly, some power might be generated at Sardar Sarovar river bed power house with these excess inflows but its economic feasibility is in doubt. There would be no canal power house. Ignoring generation with any excess inflows, the total generation with Jalsindhi FRL +455 would be 960 MKWH, the same as with Sardar Sarovar FRL +455.

14.6.5. As regards submergence, this has to be considered for Jalsindhi at RL +455 and for reduced Sardar Sarovar at RL +309. At these levels, the areas submerged would be :

	Gross
Jalsindhi + 455	59,380 acres.
Sardar Sarovar + 309 . . .	14,370 acres.
	73,750 acres.

Against this submergence, that by Sardar Sarovar at RL +455 would be 91,500 acres gross. Thus, Jalsindhi and reduced Sardar Sarovar submerge about 73,750 acres. It might be pointed out that the Harinphal Project, 1972, of Madhya Pradesh (Exhibit MP-327) envisaged submergence upto RL+460 and stipulated acquisition of 38,500 acres of land. Of this, 26,065 acres comprised culturable area, vide Vol. I, page 79, as against 30,000 acres in the case of high Sardar Sarovar.

13.6.6. Considering that Jalsindhi FRL+455 and Sardar Sarovar FRL +309 together (a) allow a good deal of water to go waste to the sea, (b) are unsatisfactory in providing irrigation supplies to Navagam Canal and (c) generate nearly the same quantum of power as high Sardar Sarovar, the preference has to be for a high Sardar Sarovar notwithstanding a somewhat larger submergence of land.

Advice of the Assessors

13.7.1. We have consulted our Technical Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyer with regard to the subject matter of this chapter. They have advised us that they all agree with the conclusion reached in paragraph 13.6.6 and also the reasoning given by us in the previous paragraphs.

STATEMENT 13.1

POWER GENERATION AT JALSINDHI WITH FRL + 420

(On full development of irrigation, in a year of 75 per cent dependability)

Inflow At Jalsindhi	*MAF*
Requirement of Navagam Canal	9.50
*Difference in evaporation loss between high Sardar Sarovar and Jalsindhi with low Sardar Sarovar	0.18
i.e. Flow Past Jalsindhi	9.68

For want of capacity in low Sardar Sarovar, no contribution can be availed of from the catchm ent area below Jalsindhi. Therefore, the outflow required to pas Jalsindhi is 9.68 MAF.

Power Generation At Jalsindhi

With FRL+420, MDDL + 339' and average TWL + 210, the effective head is 183 feet.

Power generated with this head. MAF at 100% L.F.

$$= \frac{1381 \times 183}{14 \times 1000} = 18.05 \text{ MW}$$

Energy generated with 9.68 MAF per annum.

$$= \frac{18.05 \times 9.68 \times 8760}{1000}$$

= 1531 MKWH

*(Evaporation loss from Sardar Sarovar is taken as 0.5 MAF and Evaporation loss from Jalsindhi is taken to be the same as for FRL+ 455 i.e. 0.32 MAF).

STATEMENT 13.2

POWER GENERATION AT SARDAR SAROVAR WITH FRL +455′ AND NAVAGAM CANAL FSL +306′.

I. At Canal Head Power House

FRL +455′

MDDL +363′

Average TWL +307

Effective head = 2/3 (FRL —□ —MDDL) MDDL—Average TWL

= 2/3 (455—363) + 363—307

= 117.3 say 117 feet.

Power generated per MAF at 100% L.F.

$$= \frac{1381 \times 117}{14 \times 1000}$$

= 11.54 MW

Draft per annum = 9.5 MAF

Power generated at 100% L.F.

= 11.54 x 9.5 = 109.64 MW

Energy generated per annum.

$$= \frac{109.64 \times 8760}{1000}$$

= 960 MU

II. *At River Bed Power House*

FRL + 455′

MDDL + 363′

Average TWL +85′

Effective head = 2/3 (455—363) + 363—85

= 339.3′ say 339 feet.

Power generated per MAF at 100% L.F.

$$= \frac{1381 \times 339}{14 \times 1000} = 33.44 \text{ MW}$$

Draft/annum is nil (in the final stage), therefore no power generation is possible.

STATEMENT 13.3

POWER GENERATION IN EARLY STAGE OF IRRIGATION DEVELOPMENT

It is assumed that after 10 years of the commencement of development of irrigation, the flows in a year of 75 per cent dependability would be as follows :—

	MAF
At Jalsindhi	19.36
Into Navagam Canal	3.05
Into the river from Sardar Sarovar	16.31

Power Generation

I. Jalsindhi FRL + 420 (MDDL + 339) and Sardar Sarovar FRL + 210

Power Generation at Jalsindhi at 100% L.F.

$$= \frac{19.36 \times 183 \times 1381}{14 \times 1000}$$

$$= 349 \text{ MW}$$

Power generation at Sardar Sarovar at 100% L.F.

$$= \frac{16.31 \times 119 \times 1381}{14 \times 1000}$$

$$= 191 \text{ MW}$$

Total generation = 349 + 191

= 540 MW

II. Sardar Sarovar FRL + 455

Power generation at Canal Head Power House @ 100% L.F. and effective head of 117 feet.

$$= \frac{117 \times 3.05 \times 1381}{14 \times 1000}$$

$$= 35 \text{ MW}$$

Power generation at River Bed Power House @ 100% L.F. and effective head of 339 feet.

$$= \frac{339 \times 16.31 \times 1381}{14 \times 1000}$$

$$= 545 \text{ MW}$$

Total generation = 35 + 545 = 580 MW.

STATEMENT 13.4

POWER REQUIREMENT FOR PUMPING TO BRING THE COMMAND AREA OF +190 CANAL TO THE STATUS OF + 300 CANAL

Culturable command of + 300 Canal for 9 MAF utilization is 56.92 lakh acres, 52.99 lakh acres by flow and 3.93 lakh acres by lift.

Culturable command of + 190 canal for 9 MAF utilisation is also 56.92 lakh acres, of which 32.27 lakh acres are by flow and 24.65 lakh acres by lift.

To bring the command of + 190 canal to the status of + 300 canal, water will have to be lifted by 110 ft for area in Gujarat as under .—

Flow converted to lift	20.72 lakh acres (52.99—32.27)
Lift area with increased lift	3.93 lakh acres
	24.65 lakh acres

Pro rata, 24.65 lakh acres would require 3.90 MAF of water and this would have to be lifted by 110 feet. In addition, 0.5 MAF for Rajasthan would require lifting by 110 feet.

$$\text{Power required for lifting 4.4 MAF } (3.90 + 0.50) \text{ of water by 110 feet} = \frac{4.4 \times 1381 \times 110 \times 8760}{10 \times 1000}$$

$$= 586 \text{ MKWH}$$

STATEMENT 13.5

POWER GENERATION AT JALSINDHI WITH FRL + 455′ AND SARDAR SAROVAR FRL + 309′

MDDL — RL + 358′

Average TWL — RL + 308′

Effective head = ½(455—358) + 358—308′

= 114.66 say 114.7

Power generation per MAF at 100% L.F.

$$= \frac{1381 \times 114.7}{14 \times 1000}$$

= 11.31 MW

Energy generated per annum with 9.68 MAF

$$= \frac{11.31 \times 9.68 \times 8760}{1000}$$

= 959 MU say 960 MU

CHAPTER XIV

DISTRIBUTION OF COSTS AND BENEFITS

14.1.1 On the assumption that the height of the Sardar Sarovar Dam is fixed at FRL 455 and MWL 460 and that Gujarat is permitted to build the dam upto that height, the important question arises whether and to what extent Maharashtra and Madhya Pradesh are entitled to compensation for deprivation of electric power on account of submergence of Jalsindhi dam site FRL 420. (Maharashtra Project Report Ex. MR-137).

14.1.2 This question is the subject matter of the modified issue 17 which states :

> "17. Whether the costs and benefits of the Navagam project of Gujarat are required to be shared amongst the concerned States. If so, in what manner and on what terms and conditions ? If not, whether Gujarat is liable to pay any, and if so, what compensation to Maharashtra and/or Madhya Pradesh for loss of power ? Whether Maharashtra and/or Madhya Pradesh are entitled to any share of power because of their proposed projects, namely, Jalsindhi, Harinphal and Maheshwar."

14.1.3 In the Maharashtra Statement of Case, Vol. 5 in paras 4.5.3 and 4.5.4, pages 30-31, para 6.1.27, pages 76-77 and prayer (d) of reliefs at pages 89-90, it was claimed on behalf of Maharashtra that there should be two separate equitable apportionments of Narmada waters for consumptive and non-consumptive uses. But in the course of argument, Shri Nariman clarified that there should be only one equitable apportionment of the waters of Narmada for consumptive uses and as regards submergence of the Jalsindhi dam site, both Madhya Pradesh and Maharashtra are entitled, as a matter of principle, not only to compensation of the lands and properties inundated in the two territories but there should also be restitution to the two States of the full power they could obtain by their own scheme. It was argued for Maharashtra that in determining the compensation, the scope of the enquiry is not restricted to the value of the lands or the buildings inundated, but what Maharashtra and Madhya Pradesh, if they had not been prevented, would have made out of this admittedly valuable assets. The enquiry was not restricted to compensation for mere potentiality of the site, but would necessarily include the full realised possibility of the site, which is inundated. It was maintained that there must be *restitutio in integrum* and the parties injured must be put in the same position as they would have been if the injury had not taken place.

14.1.4 In our opinion, the claim of Maharashtra set out in the original Statement of Case is not warranted in law. There is only one equitable apportionment to be made by the Tribunal of the waters of Narmada for consumptive uses between the party States. If, as a result of this equitable apportionment, there is injury caused to States of Madhya Pradesh and Maharashtra by reason of the inundation of the Jalsindhi dam site, the question of compensation or restitution for the injury is consequential and itself constitutes a part of the larger question of equitable apportionment. The matter is clearly stated by Eduardo Jimenez De Arechaga :—

> *"The Principles of Equitable Apportionment of Benefits* : For the foregoing reasons, the policy has gained favour that, before undertaking works utilising water, it is necessary that a system of adequate compensation be established *and agreed upon in advance* and that such compensation whether provided for in a treaty or in a judicial arbitral award, should be guided by certain principles, summed up in the idea of equitable apportionment. The basis of equitable apportionment is that co-riparian States have the right to obtain in advance adequate compensation in kind for substantial injuries which may be caused by proposed change in some part of the basin."

14.1.5 This view is also supported by the comments of the International Law Association to the Helsinki Rules[1] :

> "By way of example, suppose that State A, a lower co-basin State, has, for many years, used the waters of an interantional river for irrigation purposes. State B upstream now wishes to utilise the waters for hydro-electric power production. The uses for hydro-electric and irrigation purposes are in partial conflict because the storage period for the hydro-electric use overlaps the growing season . . . . The employment of anyone or some combination of the above measures may suffice to reconcile the conflict. If no other solution can be found, however, one of the uses may necessarily have to prevail to the impairment of the other use ; the amount and kind of compensation, if any, to the States deprived of its use would then be determined. Irrigation although an existing use may nevertheless be required to give way

[1] Pages 785-786 in Olmstead's "International Drainage Basins"

since the weight of the factor, favours the hydro-electric use.

There are alternative sources of electricity available to State B, but at a higher cost. State A may be required to compensate State B for all or part of the cost differential, if the use of the waters for the production of power is precluded or limited.

This illustration shows how the several factors relevant to the particular case are to be considered and how the principle of equitable utilisation is applied in order to achieve a fair and just settlement."

14.2.1 It was then maintained on behalf of Madhya Pradesh and Maharashtra that the compensation for the loss of Jalsindhi dam site must be based on the bed-fall principle. In support of this contention, reference was made to the Lisbon Convention of 11th August, 1927, Article V of the Berne Convention dated 4th October, 1913, the Strasbourg Agreement of 10th May, 1922 and Article 5 of Reno di lei Agreement dated 18th June, 1949 (See Exs. MP-971, MP-873 and MP-974).

14.2.2 It is an accepted legal doctrine that the existence of customary rules of international law, i.e., a practice accepted as law, may be inferred from similar provision in a number of treaties. But what is the precise legal basis on which the doctrine is based ? So far as the treaties cited in the last paragraph are concerned, they are merely obligations entered into bilaterally or multilaterally by formal consent. In other words, they are nothing more than contractual rules limited to the specific matter and binding only on the parties expressly signing the contract. It is true that these provisions may develop into international law by general acceptance by other nations. It is inaccurate therefore to consider that treaties by themselves are the source of general international law. (Hyde — International Law, Vol. I, pages 10, 11—2nd Edition, 1945). It must be emphasised that the law creating fact is *still custom* and not the treaty contract as such. The provision of treaties, even though contractual, may demonstrate and even generate usage. But additional evidence is normally required to prove on the basis of any such usage the development of custom. To put it differently, the conclusion of treaties are but incidents in the broader and lengthier process of the formation of custom. (*See* Olmstead—Law of International Drainage Basin, 1967, pp. 870, 871).

14.2.3 Speaking of international custom, Professor Julius Stone states :

> The "international custom" which the Court is to apply under the second Head (b) is subject to difficulties of ascertainment considered elsewhere; and this requires the Court to "find" and "declare" the law. .... *It is to be noted that treaties may have to be resorted to under this second as well as the first head.* For, quite clearly, even if a treaty does not establish any rules expressly recognised by the contesting parties, the fact of its conclusion may constitute evidence of an "international custom" evidencing a general practice accepted as law within Head (b), just as may decisions of municipal courts, diplomatic exchanges or protests.
>
> (Emphasis added.) (STONE, Legal Controls of International Conflict 135) (1954).

According to Fauchille :

> Lorsque plusieurs traites, conclus a differente epoques ou a une meme epoque, entre des Etats civilises, reproduisent d 'identiques stipulations le principe que revelent ces stipulations conformes a la valeur d 'une regle juridique . . . . Mais il faut se garder d' errer sur le caractero d'une semblable regle. Elle n'est pas conventionalle; elle est coutumiere. (I FAUCHILLE, TRATTE DE DROIT INTERNATIONAL PUBLIC 45-46) (No. 52).

Rousseau says :

> Certains traites particuliers (traites d'arbitrage, conventions consulaires, traites d'extradition, traites, relatifs aux canaux internationaux) peuvent contribuer a l'elaboration du droit coutumier lorsqu'ils sont conclus entre un grand nombre d'Etats, et qu'ils contiennent des stipulations identiques. (clauses-type) reflctant une conviction juridique commune. (ROUSSEAU, DROIT INTERNATIONAL PUBLIC 67) (1953).

14.2.4 In the present case, the precedents furnished by Madhya Pradesh and Maharashtra do not establish as a matter of law that the bed fall principle is the legally correct measure of compensation for the submergence of Jalsindhi dam site. In order to prove custom, there must be established usage regarded by the parties as obligatory in character. There must be a clear and continuous habit of doing certain actions and the conviction of the participants that these actions are both obligatory and legally right. In other words, only those practices give rise to customary law which are accompanied by the feeling of consciousness of a legal duty—*opinio juris vel necessitatis*. In the Asylum case[2] the International Court of Justice relying on Article 38 of its Statute formulated the requirements of custom in International Law as follows :—

> "The party which relies on a custom of this kind must prove that this custom is established in such a manner that it has become binding on the other party. The Columbian Government must prove that the rule invoked by it is in accordance with a constant and uniform usage practised by the States in question and that this usage is the expression of a right appertaining to the State granting asylum and a duty incumbent on the territorial State."

14.2.5 Even assuming in favour of Maharashtra and Madhya Pradesh that the treaties (Exs. MP-971, 973

[2] (1950) I.C.J. Report 266(276).

and 974) prove the bed fall principle as a customary rule of law for European rivers, it is not possible for us to extend the same principle to Indian rivers like Narmada. In the Asylum case (1950) I.C.J. Reports 266 at p. 277, the International Court ruled that one custom cannot be deduced by analogy.

> "The Court cannot therefore find that the Columbian Government has proved the existence of such a custom. But even if it could be supposed that such a custom existed between certain Latin American States only, it could not be invoked against Peru...." (P. 277).

The matter has been clearly put by Hyde[3](1) as follows :—

> "It is to observed that treaties have generally not purported to provide for more than the requirements of the contracting parties with respect to the particular river concerned. Acts such as those of the Congress of Vienna or of the Berlin Conference must be regarded as having been designed primarily to apply the principles enunciated to the problems peculiar to special groups of rivers within specified areas. Inasmuch as fluvial conditions in Europe, in North America, in South America and in Africa are not the same and differ sharply according to geographical and other conditions distinctive of each continent, the attempt still remians futile to lay down rules applicable all alike to all international waterways..... Riparian States have not sought to do so. . . The documents which have been examined reval not only the strength of the considerations that have moulded the policy of a conventional fluvial law applicable to rivers traversing particular areas, but also the difficulty in establishing that there are rules universally applicable to what may be called the international navigable rivers of every continent, and which are deemed to be incorporated in the law of nations and hence obligatory upon all concerned . . . . "

14.2.6 In the present case, there is no material adduced on behalf of Madhya Pradesh and Maharashtra which show that the bed fall principle has been accepted in any of the inter-State agreements in India with regard to apportionment of electric power. It is true that the Jalsindhi Agreement dated 5th April, 1965 contains such a clause but this Agreement was entered into between Madhya Pradesh and Maharashtra during the pendency of the dispute before the Khosla Committee and is not of much evidentiary value. The agreement may be binding as a bilateral contract between the signatory States but cannot be accepted as any proof of international or inter-State customary law. Tested in the light of principles which we have already enunciated, we are unable to say that either Madhya Pradesh or Maharashtra has fulfilled the burden of showing the requirement of *opinio juris*. Nor have they produced a sufficient number of geographically diverse agreements nor furnished other evidence of a clear and continuous course of conduct with regard to the apportionment of electric power between various States either in India or elsewhere. We accordingly reject the argument of Madhya Pradesh and Maharashtra on this aspect of the case.

14.3.1 It was next submitted on behalf of Madhya Pradesh and Maharashtra that Jalsindhi dam FRL 420 with Navagam Dam FRL 210 would produce more power in the interim and final stages than a dam of equivalent height at Navagam with Canal Level 300 and it was therefore imperative that there should be *full* restitution to Maharashtra and Madhya Pradesh for the power they could have produced at Jalsindhi according to their own project report. The argument was stressed that "Gujarat should not be permitted to build a dam above FRL 210 unless it agrees to give suitable guarantee for compensation in terms of power or equivalent monetary compensation to Maharashtra and Madhya Pradesh". (See Maharashtra Note 43 and Madhya Pradesh Written Argument Volume 13).

14.3.2 In our opinion, there is no warrant for the argument that there must be *full compensation* for the damage sustained by a co-riparian State in dealing with the problem of equitable apportionment of waters. In Kansas v. Colorado (185 U.S. 125), Kansas argued that Colorado was violating "the fundamental principle that one must use his own so as not to destroy the legal rights of another, (Sic utere tuo ut alienum non laedas)", but the Supreme Court pronounced the rule of equitable apportionment as the dominant principle of the law of inter-State rivers, and, in subsequent cases, the Supreme Court adhered to that principle even though prior legal rights under the law of another State were destroyed in the application of that principle.

14.3.3 In another case, Nebraska v. Wyoming (325 U.S. 589) to which Colorado was also a party, Nebraska complaining of damage by increasing diversions from the North Platte River upstream in Wyoming and Colorado sought an equitable apportionment of the waters of the river and injunction restraining wrongful diversions. The question for decision of the Court was whether, as Wyoming contended, the principle of priority of appropriation in force in the three states should be applied. If it did apply, Wyoming's prior uses could not be injured. The Supreme Court decided that in the circumstances of the case, an equitable apportionment would not result from the application of a strict doctrine of priority of uses, and held that Colorado's subsequent existing uses should be sanctioned notwithstanding that they deprived prior users in Nebraska of the water for their established irrigation. The result of the judgement was that subsequent utilisation in Colorado which had adversely affected prior beneficial uses in Wyoming were not disturbed. Furthermore, nothing was said about any obligation of Colorado to pay compensation for injuries to existing uses. The primary objective of the Court therefore was an equitable apportionment of the beneficial uses of the inter-State waters and not the protection of prior uses. This was made clear in the statement that "the equitable share of a

(1) HYDE—International Law chiefly as interpreted and applied by United States 12(1945)

state may be determined in this litigation with such limitations *as the equity of the situation requires* and irrespective of the indirect effect which that determination may have on individual rights within the State. "(325 US 589, 618). The Supreme Court therefore held that considerations of equity allowed Colorado to deprive Nebraska's prior uses of water with impunity.

14.3.4 As we have already stated, international law imposes a general limitation upon action that one State may take which would cause injury in the territory of another State. (Societe Energie Electrique, v. Compagnia Imprese Electtriche Liguri, 64 Foro Italiono, I, 103, 9 Ann. Dig. 120 (Italy, Court of Cassation, 1939). But the international duty is not an absolute one and must be considered from the overall perspective of what constitutes an equitable utilisation. It would be seen that the international duty cannot be applied without reservation or qualification to a State whose use of water is consistent with the equitable utilisation of such water. This view is supported by Article X(1) of Helsinki Rules which states :—

> "1. *Consistent with the principle of equitable utilisation of the waters of an international drainage basin,* a State
>
> (a) must prevent any new form of water pollution or any increase in the degree of existing water pollution in an international drainage basin which would cause substantial injury in the territory of a co-basin State, and
>
> (b) should take all reasonable measures to abate existing water pollution in an international drainage basin to such an extent that no substantial damage is caused in the territory of a co-basin State."

In its comments on this Article, the International Law Association states :—

> "Any use of water by a basin State, whether upper or lower, that denies an equitable sharing of uses by a co-basin State conflicts with the community of interests of all basin States in obtaining maximum benefit from the common resource. Certainly, a diversion of water that denies a co-basin State an equitable share is in violation of international law. A use that causes pollution to the extent of depriving a co-basin State of an equitable share stands on the same basis. By parallel reasoning, a State that engages in a use or uses causing pollution is not required to take measures with respect to such pollution that would deprive it of equitable utilization."
>
> * * * *
>
> "The rules stated in this Article place a duty upon a basis State, consistent with that State's right to an equitable utilization, to take the specified measures respecting pollution of water. Thus, the international duty stated in this Article regarding abatement or the taking of reasonable measures is not an absolute one. *This duty, therefore, does not apply to a State whose use of the waters is consistent with the equitable utilisation of the drainage basin.* (See generally 2.E. Jimenez de Arechaga, Curso de Derecho Internacional Publico 532—534 (1961)."
>
> ** ** **
>
> "Pollution as that term is used in this Chapter may be the result of reasonable and otherwise lawful use of the waters of an international basin. For example, the normal process of irrigation for the reclamation or arid or semi-arid land usually causes an increase in the salinity of the downstream waters. Modern industrial processes of a very valuable and useful nature may result in the discharge of deleterious wastes that pollute the water. Frequently rivers are the most efficient means of sewage disposal, thereby causing pollution of waters. Thus as pollution may be a by-product of an otherwise beneficial use of the waters of an international drainage basin, the rule of international law stated in this Article does not prohibit pollution per se. (Of 2 Jimenez de Arechaga, Curso de Derecho Internacional Publico 529-530 (1961); Fenwick, International Law, 363—365 (4th ed 1965)." (Quoted from Olmstead—Law of International Drainage Basin page 795).
>
> ** ** **

14.3.5 About the use of the *sic utere tuo* maxim in problems of apportionment of the waters of international rivers, professor Andrassy has written as follows :—

> "Toutefois, 1 'interdiction de leser les interets d'un autre Etat ne peut pas etre fondee sur une formule aussi generale. En poursuivant ses propres interets legitimes, 1'Etat se trouve souvent dans la situation de leser ; volontairement, les interets d'un autre Etat. Une regle tres ancienne constate. "Qui jure suo utitur neminem laedit". Un auteur observe a juste titre : "Il n'y a quela lesion contraire au droit qui est interdite, D'apres le droit international auss i, un Etat peut causer de prejudice a un autre Etat a son gre, pourvu qu'il le fasse en exercise d'un droit propre." Il faut done que l'interet lese soit lui-meme protege par le droit international. Il faut done que l'interet lese soit lui-meme protege par le droit international.[8]
>
> (Nevertheless the forbidding of doing wrong or injuring the interests of another State cannot be justified on a formula so general. By pursuing its own legitimate interests, a State may often find itself in the situation of doing injury voluntarily or involuntarily to the interests of another State. A very old rule establishes "Qui jure suo utitur neminem laedit". One author has rightly observed "It is only the injury contrary to a lawful right

[8] Andrassy, "L' utilisation des eaux des bassins fluviaux internationaux, 16 Revue-Egyptienne de Droit International 23, 34 (1960). He gives another example of an act which causes injury and yet is lawful; see ibid., 35–36.

which is prohibited." According to the international law also, a State may cause injury to another State knowingly in exercise of its own legitimate right. It is therefore necessary that the interest injured is itself protected by international law.)

14.3.6 In our opinion, the question whether a coriparian State is entitled to any compensation for submergence of a dam site and the further question as to the quantum of such compensation cannot therefore be answered in absolute terms but will depend upon the equities of each particular case.

14.3.7 Having regard to the equities of the present case, we shall now proceed to indicate as to how the question of compensation to Madhya Pradesh and Maharashtra is to be assessed for deprivation of electric power on account of submergence of Jalsindhi Dam Site.

14.4.1 Jalsindhi and Harinphal are projects in the proposal stage and have undergone changes in concept since they were first mooted. The following statement will briefly indicate the changes :—

		Harinphal	Jalsindhi
(i) Proposed to Khosla Committee	(1965)	FRL-465 TWL-355	FRL-355 TWL-210
(ii) Proposed by Maharashtra (Not approved by Madhya Pradesh)	(1968)	—	FRL-465 TWL-210
(iii) Master Plan (Ex-MP-312)	(1972)	FRL-455 TWL-355	FRL-355 TWL-210/ 200
(iv) Modified Harinphal Project	(1975)	FRL-420 TWL-355	FRL-355 TWL-210/ 200
(v) Modified Jalsindhi Project	(1977)	..	FRL-420 TWL-210

Changes (iii) and (iv) purport to have been made with a view to reduce submergence. The last change has apparently been made to provide sufficient storage (according to Madhya Pradesh and Maharashtra) for meeting the irrigation requirements of Gujarat upto 10 MAF/year.

14.4.2 In this context, it is necessary to state that the power expected to be generated as per project report of Jalsindhi (as revised finally with no Harinphal) vide Exhibit MR-137, is—

(a) In the initial stage	309 MW @100% LF
(b) In the final stage	59 MW @100% LF

The above figures of power are based on an expected regulated flow of 3.263 MAF/year at 90 per cent reliability in the final stage. This regulated flow in the final stage is in accordance with the proposals made in Master Plan of Madhya Pradesh, Ex MP-312. If there was no inter-State dispute and if Madhya Pradesh and Maharashtra were free to utilise the Narmada water for their irrigation and power requirements for their own optimum benefit, the power generated in the river below Maheshwar would be as stated above. It was expected, in the Master Plan of Madhya Pradesh, that Gujarat's requirement of water for consumptive use will not exceed what could be obtained with a regulated flow of 4.443 MAF/year (at 75 per cent reliability) flowing past Jalsindhi and the available unregulated flow below Jalsindhi.

14.4.3. The Tribunal has decided to make allocation of Narmada waters for consumptive use of Gujarat to the extent of 9 MAF and according to agreement of July, 1974, among the Chief Ministers, Rajasthan has been allocated 0.5 MAF of Narmada waters. Thus, as against 4.443 MAF/year anticipated as the regulated flow past Jalsindhi according to the Master Plan of Madhya Pradesh there is to be a regulated flow of 9.5 MAF in terms of the award of the Tribunal. It is the case of Madhya Pradesh and Maharashtra that the power availability as per Jalsindhi Project, Exhibit MR-137, should be revised so as to fit in with the Tribunal's allocation of water to Gujarat when estimating the power loss.

14.4.4 In our view such a contention is not acceptable. The Tribunal's award not only determines the allocation of water to Gujarat but also the level at which the water has to be diverted for use by that State and Rajasthan. This level viz., the FSL of the Navagam Canal is 300 ft. and as a consequence, the tail water level of any power development scheme upstream of Sardar Sarovar has to be at a level to accord with the FSL of 300 ft. for Navagam Canal. This will reduce the power potential of the Jalsindhi Project which is designed for a tail water level of 210 ft. Hence, while the award in respect of allocation of water to Gujarat increases the power potential of Jalsindhi from what the Project Report contemplated, the same award in respect of FSL of canal level will cause reduction in such power potential. The two factors have to be taken together in assessing what should be the equitable compensation of power to be made to Madhya Pradesh and Maharashtra.

14.4.5 There is another factor which may be considered in this connection. As stated in para 14.4.1, the FRL of Harinphal Project which was fixed at 455 ft. in the Master Plan Ex. MP-312 was lowered to 420 ft. with a view to reduce submergence. When Jalsindhi and Harinphal were later combined into one scheme vide Ex MR-137, the FRL was retained at 420 ft. The Tribunal's award in respect of FRL of Sardar Sarovar is 455 ft. and this will cause submergence of the lands which the reduction of Harinphal FRL from 455 to 420 ft. sought to avoid. Hence, when assessing the prospective power loss it is reasonable to assume FRL of 455 ft. at Jalsindhi.

14.4.6 Thus the proper approach is to consider what would be the power that could have been generated in a national Jalsindhi scheme with FRL 55, and tail water level to suit FSL of 300 ft. for Navagam Canal. The regulated flow passing through such a scheme will be 9.5 MAF/year with adjustment for difference in the evaporation loss in the final stage when irrigation and other consumptive needs are fully developed. Until such development takes place, the regulated flow available for power development will be higher. The lifting up of the tail water to suit FSL 300 canal may not apply to such extra water which is not being diverted into the Navagam Canal.

14.4.7 The power development possible from such a power scheme, as described in para 14.4.6 above, is worked out in Annexure XIV-1 to XIV-5. In this scheme, the water available and the power generation possible are worked out for three stages of development, viz.,

(a) Ist stage assumed as 10 years from the start of construction, when Narmadasagar (in addition to Tawa, Bargi, etc., already taken up by Madhya Pradesh) becomes operative and Jalsindhi Dam and power house (or Sardar Sarovar Dam with the same FRL) is completed. Madhya Pradesh, Maharashtra, Gujarat and Rajasthan would be utilising 6 MAF, 0.25 MAF, 2.55 MAF and 0.5 MAF respectively. (See Annexure XIV-4).

(b) 2nd Stage assumed as 30 years from the start of construction, by which time some more dams would have been added. Gujarat expects full development of irrigation to take place by that time. The consumptive water requirement of the different states at that time is expected to be 13.0 MAF, 0.25 MAF, 9 MAF & 0.5 MAF by Madhya Pradesh, Maharashtra, Gujarat and Rajasthan respectively ; and

(c) 3rd Stage assumed as 45 years from the start of construction. Madhya Pradesh has assumed that construction of all the major dams and other projects will be completed in 35 years and full development of irrigation would take about 7 years thereafter i.e. 42 years. Considering the large number of projects involved, we consider that this is more likely to be 45 years for full development of irrigation.

14.4.8 The available regulated flow is considered in two parts viz., (a) canal component which represents the part of the regulated flow which will have to be diverted into Navagam canal, and (b) the river component which comprises of the rest of the available regulated water. As already stated, the former will be considered to operate with a tail water level to suit diversion Navagam Chanal FSL 300 ft. which will be 308 ft. The latter or river component will be considered to operate with a tail water level suitable for the site conditions at Jalsindhi dam site, which will be 210 ft.

14.4.9 The power generation possible, and the number of units of energy generated as worked out in Statement 14.1 are extracted below :—

	Power at 100% LF	Energy per year
Ist stage—(10 years from start)	377 MW	3305 MU
2nd Stage—(30 years from start)	210 MW	1848 MU
3rd stage—(45 years from start)	112 MW	977 MU

It will be seen that these figures are much higher than those of Jalsindhi Project Report (see para 14.4.2) even allowing for the fact that the project is based on 90 per cent reliability of flow while the figures as per the notional scheme worked out in this para are at 75 per cent reliability.

14.4.10 The power available from schemes in the river will vary from year to year depending upon the hydrological conditions and the extent of consumptive utilisation for irrigation etc., upstream of the project. In the case of the notional project at Jalsindhi described in para 14.4.6 above, this will also vary with the extent of consumptive use downstream of the dam which determines the canal component. Hence, for purposes of compensation, it is reasonable that the extent of power to be restituted is fixed as a percentage of the power generated at Sardar Sarovar rather than being fixed in absolute terms as so many MW of power or millions of units of energy per year. The power generation at Sardar Sarovar is subject to the same yearly variations in regard to availability of water and canal utilisation as the scheme at Jalsindhi. Hence, when the compensation is expressed as a percentage of the Sardar Sarovar Power, the variations due to hydrological conditions and stage of consumptive utilisation would be properly taken care of.

14.4.11 In Statement 14.1 and Annexures XIV-3 to XIV-6, the power generation possible at Sardar Sarovar both in the canal Power House and at the river bed are worked out for the same three stages of development as in para 14.4.7. These are given below :—

	Power in MW at 100% LF		Energy in MU per year	
	Canal	R.B.	Canal	R.B.
Ist stage . .	35+	545	308+	4775
2nd stage . .	110+	158	960+	1386
3rd stage . .	110	—	960	—

It should be noticed that the power generation and units of energy available per year are more than the corresponding figures for the Jalsindhi scheme vide para 14.4.9 at all stages combined. The latter in turn are higher than those contemplated in the Project report (para 14.4.2).

14.5.1 For the purpose of compensation, we consider that the estimated power as per the notional scheme should be reckoned as the equitable measure of loss of benefit. To work out this estimate as a percentage of the corresponding power benefit from Sardar Sarovar, the total energy units which can be generated during the life time of the dam (estimated as 100 years from completion of construction) is taken as the basis. Out of the 100 years, 35 years will be covered upto stage 3, and the remaining 65 years will be continued at stage 3 level. The total energy which can be generated at Sardar Sarovar and Jalsindhi during the 100 years after construction will be 1,61,485 MU and 1,36,223 MU, respectively. On the basis of the energy availability, the loss of benefit at Jalsindhi will be 84 per cent of the power benefit from Sardar Sarovar. This leaves 16 per cent of the power benefit from Sardar Sarovar to Gujarat, the balance of 84 per cent being shared by Madhya Pradesh and Maharashtra as compensation of the loss of prospective power at Jalsindhi/Harinphal.

14.6.1 The compensated power is to be shared between Madhya Pradesh and Maharashtra. We consider that this sharing should be done on the basis of the

Jalsindhi agreement, clauses 3 and 4 of which are reproduced below :—

"(3) The costs of the works at Jalsindhi will be shared between Madhya Pradesh and Maharashtra in the ratio of $a + \frac{b}{2} : \frac{b}{2}$ where 'a' is equal to the fall in the river between Harinphal and the point where one bank of the river enters Maharashtra and 'b' is equal to the fall in the river in the portion where it runs along the boundary between the two States.

(4) The net benefits from the Jalsindhi Project (i.e. excluding such credits as have to be afforded to the upstream projects for the regulated supplies received at Jalsindhi from those projects and including such credits as would be afforded by the downstream projects for the regulated supplies delivered from Jalsindhi) will be shared between the two States in the same proportion as the costs."

According to the above agreement, Madhya Pradesh should get 67.5 per cent of the restituted power and Maharashtra 32.5 per cent of the same. Calculations in support of these percentages are given in Annexure XIV-7.

14.6.2 Thus out of the net power produced in Sardar Sarovar at canal head and river bed power houses on any day,

Share of Madhya Pradesh will be 57 per cent
Maharashtra's share will be 27 per cent
Gujarat's share will be 16 per cent

14.6.3 In the normal course, the direction would be that the restituted power should be made available at the Jalsindhi switchyard. However, it is possible that Madhya Pradesh and Maharashtra may choose some other more convenient point to receive their share of power supply when Jalsindhi scheme is not being executed. It is necessary that Gujarat should construct and maintain a transmission line from the Sardar Sarovar switchyard to a linking station, close to its border from which Madhya Pradesh and Maharashtra may find it suitable to receive their power supplies.

14.7.1 Madhya Pradesh has claimed that the restituted power should be supplied to it at the cost at which it could have been generated at Sardar Sarovar or its own sites whichever is cheaper (MP Written Submission XIII Para 17.7). Maharashtra has contended that it should be at the cost of generaion at Jalsindhi. It is not, however, possible for us to accept the contention of Madhya Pradesh or Maharashtra. In the case of several projects which take a number of years to complete, it is the general experience that the actual cost of construction is much higher than the estimated cost due to various reasons such as increase in prices, unforeseen difficulties etc. Hence, it is not proper to fix the price of the power and energy on the basis of the estimated cost of power generation according to the project report as claimed by Madhya Pradesh and Maharashtra. It is proper and more realistic to fix the price from the cost of power generation at Sardar Sarovar on the basis of actuals. With a view to ascertain whether there is likely to be large variation in the unit cost of power between Jalsindhi and Sardar Sarovar power complex, a study of comparative costs based on the updated estimates submitted by the party States has been made in Statement 14.3. It will be noticed therefrom that the unit costs are more or less equal, Sardar Sarovar power being cheaper after allowing for amortisation of the capital cost of the River bed Power House which may become defunct after stage 3 due to lack of water. It may be stated in this connection that Madhya Pradesh and Maharashtra have expressed their unwillingness to participate in the capital cost of Sardar Sarovar power complex. However, these States would have to make substantial financial investments for getting a similar quantum of power from Jalsindhi. In our opinion, the objections of Madhya Pradesh and Maharashtra to participating in the capital cost in Navagam power complex are not acceptable. We consider it reasonable that Madhya Pradesh and Maharashtra should contribute their share to the capital cost of Sardar Sarovar power complex in proportion to their entitlement of power and energy. We should add that the Khosla Committee adopted a similar method.

14.8.1 Sardar Sarovar is a multipurpose project with irrigation and power generation as its main objective. This capital cost has to be allocated suitably between the above benefits derived from it, in order to arrive at the capital cost chargeable to power generation. Following "the use of facilities" method for such allocation, the capital cost of common facilities viz., "Dam and appurtenant works" (Unit I of the Sardar Sarovar Project) should be charged to Irrigation and Power in the following proportion (See Chapter XVII) :—

Irrigation	43.9% of total cost
Power	56.1% of total cost

14.9.1 We accordingly give the following directions :—

1. The power generated in the River Bed and Canal Power House at Sardar Sarovar will be integrated in a common switchyard.
2. Madhya Pradesh and Maharashtra will be entitled to get 57 per cent and 27 per cent respectively of the power available at bus bar in the switchyard after allowing for station auxiliaries.
3. The above entitlement applies both to availability of machine capacity for peak loads and to the total energy produced in any day.
4. The entitlement of power and energy for any day can be utilised fully or partly by the concerned States or sold to another participating State under mutual agreement. It cannot, however, be carried forward except under a separate agreement or working arrangement entered into among the affected parties.
5. Gujarat will construct and maintain the transmission lines needed to supply the

allotted quantum of power to Madhya Pradesh and Maharashtra upto Gujarat State border, along an alignment as agreed to between the parties. If there is no agreement regarding the alignment it will be as decided by the Narmada Control Authority. The transmission lines beyond Gujarat State border shall be constructed and maintained by Madhya Pradesh and Maharashtra in their respective States.

6. The power houses and appurtenant works including the machinery and all installations as well as the transmission lines in Gujarat State will be constructed, maintained and operated by Gujarat State or an authority nominated by the State.

7. The authority in control of the power Houses shall follow the directions of the Narmada Control Authority in so far as use of water is concerned.

8. The scheme of operation of the Power Houses including the power and the load required by the party States during different parts of the day shall be settled between the States at least one week before the commencement of every month and shall not be altered during the month except under agreement among the States or under emergencies.

9. The capital cost of the power portion of Sardar Sarovar complex shall comprise of the following :—

   (a) Full cost of Unit-III electrical works and civil works pertaining thereto upto and including the switchyard.

   (b) Full cost of transmission lines in Gujarat State constructed for supplying power to Madhya Pradesh and Maharashtra.

   (c) 56.1 per cent of the net cost of common facilities such as Dam and appurtenant works (i.e. items included in Unit-I of the estimate for Sardar Sarovar Project) after allowing for credits, if any.

   (d) 56.1 per cent of the credit given to Madhya Pradesh for the downstream benefits derived from Narmadasagar Dam.

10. Madhya Pradesh and Maharashtra shall respectively pay to Gujarat 57 per cent and 27 per cent of the capital cost of the power portion of the Sardar Sarovar complex worked out vide item 9 above. This amount shall be paid in annual instalments until the capital works are completed. Each instalment will be worked out on the basis of the budgeted figures of the concerned works at the commencement of each financial year and shall be set off and adjusted against actual figures at the end of the financial year.

11. In addition to the payments *vide* item 10 above, Madhya Pradesh and Maharashtra shall also pay to Gujarat 57 per cent and 27 per cent respectively of the operation and maintenance costs of the Sardar Sarovar power complex each year. These payments are also to be based on budgeted figures at the commencement of each financial year and are to be adjusted against actual cost at the end of the year.

12. Notwithstanding the directions, contained hereinabove, the party States may, by mutual agreement, alter, amend or modify any of the directions in respect of sharing of power and payment for it.

14.10.1 We have consulted our Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this chapter. They all advise us that they agree with the conclusion reached in paragraphs 14.6.2, 14.8.1 and 14.9.1 and the reasoning given by us in the previous paragraphs for reaching that conclusion.

STATEMENT 14.1

COMPARISON OF POWER AND ENERGY PRODUCED AT DIFFERENT STAGES IN THE NATIONAL JALSINDHI AND SARDAR SAROVAR POWER COMPLEX

Stage of Development	Period in years	Alternative I (High Jalsindhi) FRL/455						Alternative II (High Sardar Sarovar) FRL-455'					
		Canal Component Av. TWL-308'		River component Av. TWL-210'		Total		CHPH Av. TWL-307'		RBPH Av. TWL-85'		Total	
		Power MW	Energy MU	Power MW	Energy MU	Power MW	Energy MU	Power MW	Energy MU	Power MW	Energy MU	Power MW	Eneegy MU
Ist . .	10	34.60	303	342.69	3002	377.29	3305	35.2	308	545.07	4775	580.27	5083
2nd . .	30	107.76	944	103.16	904	210.42	1848	109.64	960	158.17	1386	267.81	2346
3rd . .	45	107.76	944	3.78	33	111.54	977	109.64	960	Nil	Nil	109.64	960
end of 110 years .	110	107.76	944	3.78	33	111.54	977	109.64	960	Nil	Nil	109.64	960

Total Energy generated for a period of 100 years at :

(a) Jalsindhi

Total Energy generated between 1st and 2nd Stage (20 years)

$$\frac{3305+1848}{2} \times = 51530 \text{ MU}$$

Total Energy generated between 2nd & 3rd stage (15 years)

$$\frac{1848+977}{2} \times 15 = 21188 \text{ MU}$$

Total energy generated between 3rd and upto 110 years (65 years)

$977 \times 65 = 63505$ MU

∴ Grand total for a total period of 100 years = 51530 + 21188 + 63505 — 1,36,223 MU

(b) Sardar Sarovar Complex :

Total energy generated between 1st and 2nd stage (20 years)

$$\frac{5083+2346}{2} \times 20 = 74290 \text{ MU}$$

Total energy generated between 2nd & 3rd Stage (15 years)

$$\frac{2346+960}{2} \times 15 = 24795 \text{ MU}$$

Total energy generated between 3rd and upto 110 years (65 years)

$960 \times 65 = 62400$ MU

∴ Grand total for a total period of 100 years = 74290 + 24795 + 62400 = 1,61,485 MU

STATEMENT 14.2

PROPOSED DISTRIBUTION OF POWER BENEFITS OF SARDAR SAROVAR BETWEEN 3 STATES—MADHYA PRADESH, MAHARASHTRA AND GUJARAT

Total energy generated for a period of 100 years at Jalsindhi . . . . . =136223 MU

Total energy generated for a period of 100 years at Sardar Sarovar Power Complex . . . . . =1,61,485 MU

Thus total energy at Jalsindhi works out to 84.36% say 84% of corresponding figures at Sardar Sarovar Power Complex.

Proposed Distribution of Power benefits.

(i) Madhya Pradesh's share at 67.5M from Jalsindhi (1,36,223 MU) works out to 91,951 MU i.e. say 56.94% say 57% of Sardar Sarovar Power Complex.

(ii) Maharashtra's share at 32.5% from Jalsindhi (1,36,223 MU) works out to 44,272 MU i.e. 27.41% say 27% of Sardar Sarovar Power Complex.

(iii) Gujarat's share 1,61,485—1,36,223 = 25262 MU i.e. 15.64% say 16% of Sardar Sarovar Power Complex.

(See annexure XIV-7 for sharing between Maharashtra and Madhya Pradesh).

ANNEXURE XIV.1

REGULATED FLOW PAST JALSINDHI AT DIFFERENT STAGES AND THE CANAL AND RIVER COMPONENTS

		MAF
A. After 10 years from commencement of construction		
1. Yield of catchment at 75% dependability (Page 44 of MR-137)		26.84
2. Utilisation by M.P.		
(i) Actual use	6 MAF	
(ii) Regeneration	0.7 MAF	
Net use		5.3
3. Utilisation by Maharashtra		
(i) Actual use	0.25 MAF	
(ii) Regeneration	0.02 MAF	
Net use		0.23
4. Evaporation loss from Reservoirs (Statement attached)		1.95
Water flowing past Jalsindhi + 26.84—(5.3+0.23+1.95)		19.36
Canal Component		3.05
River Component		16.31
B. After 30 years from commencement of construction		
Water use for Gujarat and Rajasthan		9.5
Available from Madhya Pradesh's share 18.25—13.00 5.25 less 10% regeneration.		4.73
Add adjustment for evaporation losses		=0.18
Water flowing past Jalsindhi=9.5+4.73+0.18		=14.41

Note

Inflow between Jalsindhi & Sardar Sarovar is considered not utilisable as it comes in flashes.

Canal component	9.50
River component	4.91

C. After 45 years from commencement of construction :

Water flowing into Navagam Canal	9.5
Evaporation loss at Sardar Sarovar	0.5
Evaporation loss at High Jalsindhi	0.32
Evaporation loss at low Sardar Sarovar	0.10
i.e. loss at High Jalsindhi & low Sardar Soarvar	0.42
Difference in Evaporation loss will pass down into river i.e. 0.5—0.42	0.08
Evaporation loss in low Sardar Sarovar lake	0.10
i.e. water flowing past Jalsindhi	9.68
Canal Component	9.5
River Component	0.18

ANNEXURE XIV=1 (Contd.)

Statement of Evaporation Loss (For Stage I Only)

1. The evaporation loss from the reservoirs of major projects which are expected to be completed :

Name of Project	Evaporation MAF
Narmadasagar	0.88
Tawa	0.22
Barna	0.06
Bargi	0.25
Kolar	0.02
Sukta	0.01
Total	1.44

2. Evaporation loss from medium, micro minor and pumping schemes =15% of use
=15/100×1.25
=0.1875
=0.19 MAF

3. (a) Evaporation loss from Jalsindhi =0.32 MAF

(b) Total evaporation loss upto and at Jalsindhi =1.44+0.19+0.32=1.95 MAF

4. (a) Evaporation loss from Sardar Sarovar =0.5 MAF

(b) Evaporation loss upto and at Sardar Sarovar =1.44+0.19+ 0.5=2.13 MAF

TAIL WATER LEVELS OF JALSINDHI, MDDL AND AVERAGE HEAD FOR POWER GENERATION OF THE CANAL AND RIVER COMPONENTS

1. Tail Water Levels

FSL of the canal at Sardar Sarovar	=300′
Loss of Head at head regulator at the canal	=2′ (assumed)
Loss of head in the Tunnel and ponds portions	=5′ (assumed)
Minimum Water level just upsteam of Sardar Sarovar	=300+2+5+307 ft.

Assuming 20,000 Ac. Ft. required for peaking as in the case of Sardar Sarovar Ponds.

Capacity at Sardar Sarovar at 307 ft.	=1.68 MAF
Capacity at Jalsindhi at 307 ft	=0.19 MAF
Difference in capacities	=(1.68—0.19) MAF
(i.e. capacity in the lake)	=1.49 MAF

Adding peaking capacity of 0.02 MAF at the lake,

Total capacity at lake required	=1.49+0.02=1.51 MAF
At 309′ capacity at Sardar Sarovar	=1.73 MAF
At 309′ capacity at Jalsindhi	=0.21 MAF
Capacity in lake at 309′	1.73—0.21=1.52 MAF
∴ max. Lake Level	=309′
Average lake level	$\frac{307 \times 309 \text{ ft.}}{2}$
	i.e. 308 ft.

Neglecting slope loss from Jalsindhi to Sardar Sarovar, A.v. TWL of Jalsindhi=308 ft.

Inflow of 0.24 MAF between Jalsindhi & Sardar Sarovar is not considered as utilisable as no storage is provided to store these flash flows.

Capacity of Jalsindhi is approximate (See MR-137)

2. MDDL

FRL at Jalsindhi	=455 feet.
Silt storage	=0.9 MAF (assumed)
Gross storage at 455′	=2.915 MAF (as read from graph of MR-137)
Live storage	=2.915—0.9= =2.015 MAF

This live storage is available at 339′ after allowing for silt in live storage and therefore can be adopted as MDDL. However. from turbine characteristics the MDDL would be different as below :

Maximum Head=455—307=148 ft.

Design head= $\frac{2}{3}$ × 148=98.6′

Minimum head =0.5 x 98.6=49.3 say 49′

MDDL is 309+49=358 which is adopted.

3. **Average Heads :**

(At Jalsindhi)

(i) Canal component (for average TWL of 308')

$$= \frac{2}{3}(455-358)+358-308$$

$$= \frac{2}{3}\times 97+50$$

$$= 115 \text{ ft.}$$

(ii) River Component (Average TWL of 210 ft.)

$$= \frac{2}{3}(455-358)+358-210$$

$$= \frac{2}{3}\times 97+148$$

$$= 213 \text{ ft.}$$

ANNEXURE XIV-3

POWER GENERATED AT DIFFERENT STAGES IN THE NATIONAL JALSINDHI PROJECT AND THE ENERGY PRODUCED

A. After 10 years from commencement of construction

(i) Power generation at Jalsindhi for a draft of 3.05 MAF
i.e. canal component at 100% LF.

$$= \frac{3.05 \times 1381 \times 115}{14}$$

= 34.60 MW

= 303 MU per year

(ii) Power generation at Jalsindhi for a draft of 16.31 MAF(19.36—3.06)
i.e. river component at 100% LF.

$$= \frac{16.31 \times 1381 \times 213}{14}$$

= 342.69 MW

= 3002 MU per year

B. After 30 years from commencement of construction

(i) Power generation at Jalsindhi for a draft of 9.5 MAF
i.e. canal component at 100% LF.

$$= \frac{9.5 \times 1381 + 115}{14}$$

= 107.76 MW

= 944 MU per year

(ii) Power generation at Jalsindhi for a draft of (14.41—9.5) MAF

i.e. 4.91 MAF i.e. river component at 100% LF

$$= \frac{4.91 \times 1381 \times 213}{14}$$

= 103.16 MW

= 904 MU per year

C. After 45 years from commencement of construction

(i) Power generation at Jalsindhi for a draft of 9.5 MAF

i.e. canal component at 100% LF.

$$= \frac{9.5 \times 1381 \times 115}{14}$$

= 107.76 MW

= 944 MU per year

(ii) Power generation at Jalsindhi for a draft of (9.68—9.5) MAF

i.e. 0.18 MAF i.e. river component at 100% LF.

$$= \frac{0.18 \times 1381 \times 213}{14}$$

= 3.78 MW

= 33 MU per year

REGULATED FLOW PAST SARDAR SAROVAR AND UTILISATION OF CANAL HEAD POWER HOUSE AND RIVER BED POWER HOUSE AT DIFFERENT STAGES

A. After 10 years from commencement of construction

	MAF
1. Yield of the catchment of 75% dependability	27.01
2. Drawn into Navagam Canal	
(i) for Gujarat	
Total CCA 54.05 lakh acres	
vide Ex G-630 and G-630-A/1	
CCA served- 15.33 lakh acres	
vide Ex G-177 Vol IV P. 447	
Water uses $\frac{9 \times 15.33}{54.04} = 2.553$	2.55
(ii) For Rajasthan	0.5
Total	3.05
3. Utilisation by Madhya Pradesh	
Actual use 6.0 MAF	
Regeneration $\frac{6 \times 2.13}{18.25}$ 0.7 MAF	
Net use	5.30
4. Utilisation by Maharashtra	
Actual use 0.25 MAF	
Regeneration 0.02 MAF	
Net use	0.23
5. Evaporation loss from Reservoirs	2.13
6. Water let down into the river = 27.01—(3.05+5.30+0.23+2.13)	16.30

B. After 30 Years from start of construction

1. Utilizable quantity at 75% dependability	28.0
2. Utilisation by Madhya Pradesh (by Linear Interpolation)	13.0
3. Available from Madhya Pradesh's share	
18.25—13.00 5.25	
Less 10% regeneration 0.52	4.73
4. Water taken into Navagam canal	9.5
5. Water let down into the river	4.73

C. After 45 years from commencement of construction.

1. Drawn into Navagam canal	9.5
2. Let down into the river	nil

TAIL WATER LEVELS OF SARDAR SAROVAR CHPH AND RBPH, MDDL, AND AVERAGE OPERATING HEADS IN THE TWO POWER HOUSES AT SARDAR SAROVAR AT DIFFERENT STAGES

A. **Tail Water Levels :**

FSL of the canal = 300′

Minimum TWL = 302′ (assumed 2′ head loss at head regulator)

Maximum Pond Level for peaking = 312′ (302+10=312)

Av. TWL considered as the average pond level $= \frac{312+302}{2}$

= 307′

B. **MDDL**

FRL at Sardar Sarovar = 455′

Maximum TWL = 312′

Minimum TWL = 302′

Head Maximum (h.max.)=FRL—Min. TWL = 455—302

= 153 feet

Design head (h. des.) $= \frac{\text{h.max.}}{3/2}$ = $153 \times \frac{2}{3}$

= 102′

Head Minimum (h. min)=

0.5 × h. design = 0.5 × 102

= 51′

i.e. MDDL = Max. TWL + h.min. = 312+51

= 363′

C. **Average Operating Head :**

(i) CHPH $= \frac{2}{3}(455—363)+363—307$

= 117.3′ say 117 feet

(ii) RBPH $= \frac{2}{3}(455—363)+363—85$

= 339.3′ say 339 feet.

POWER GENERATED AT DIFFERENT STAGES AT SARDAR SAROVAR POWER COMPLEX AND THE ENERGY PRODUCED

A. After 10 years from commencement of construction.

(i) Power generation at Sardar Sarovar CHPH at 100% LF.

$$= \frac{3.05 \times 1381 \times 117}{14}$$

= 35.2 MW

= 308 MU per year

(ii) Power generation at Sardar Sarovar RBPH at 100%LF.

$$= \frac{16.30 \times 1381 \times 339}{14}$$

= 545.07 MW

= 4775 MU per year

B. After 30 years from commencement of construction.

(i) Power generation at Sardar Sarovar CHPH for a draft of 9.5 MAF at 100% LF.

$$= \frac{9.5 \times 1381 \times 117}{14}$$

= 109.64 MW

= 960 MU per year

(ii) Power generation at Sardar Sarovar RBPH for a draft of 4.73 MAF at 100% LF.

$$= \frac{4.73 \times 1381 \times 339}{14}$$

= 158.17 MW

= 1386 MU per year

C. After 45 years from commencement of construction.

(i) Power generation at Sardar Sarovar CHPH for a draft of 9.5 MAF at 100% LF.

$$= \frac{9.5 \times 1381 \times 117}{14}$$

= 109.64 MW

= 960 MU per year

(ii) Power generation at RBPH
NIL

SHARE OF POWER BETWEEN MADHYA PRADESH AND MAHARASHTRA AS PER AGREEMENT ON JALSINDHI PROJECT

In the agreement between the Government of Madhya Pradesh and Maharashtra on the construction of Jalsindhi Project Clauses three and four read as under :—

"The costs of the works at Jalsindhi will be shared between Madhya Pradesh and Maharashtra in the ratio of a+b/2 : b/2 where 'a' is equal to the fall in the river between Harinphal and the point where one bank of the river enters Maharashtra and 'b' is equal to the fall in the river in the portion where it runs along the boundary between the two States."

"The net benefits from the Jalsindhi Project (i.e. exluding such credits as have to be afforded to the upstreams projects for the regulated supplies received at Jalsindhi from those projects and including such credits as would be afforded by downstream project for the regulated supplies delivered from Jalsindhi) will be shared between the two States in the same proportion as the costs."

From the wording of the Clause three, it appears that the bed level of the river at Harinphal and the bed levels at the commencement and end of the common boundary are the guiding criteria for sharing of power and it does not depend on the full reservoir level or the tail water level.

In the parameters agreed to by the States, the level at the commencement of the common border is 279.01 and at the end of the common border is 183.78. In the Harinphal Project, the bed level of the river is indicated as 330. Therefore, the fall in Madhya Pradesh territory alone is 330—279.01 = 50.99 which corresponds to 'a' of the agreement. The fall in the commonportion is 279.01—183.78 = 95.23 which corresponds to 'b' of the Agreement. Therefore, the share of Madhya Pradesh to the share of the Maharshtra is $50.99 + \frac{95.23}{2} : \frac{95.23}{2}$ i.e. 98.6 : 47.62. In other words, Madhya Pradesh gets 67.5% and Maharashtra gets 32.5% of the power produced at Jalsindhi.

STATEMENT 14.3

COMPARISON OF COST OF POWER GENERATION IN JALSINDHI AND SARDAR SAROVAR

I. Capital cost per KW of installed capacity

	Jalsindhi	Sardar Sarovar
Total capital cost chargeable to power	Rs. 143.7 crores	Rs. 258.72 crores
Installed capacity	7 x 80 MW =560 MW	5 x 75 MW + 5 x 150 MW =1125 MW
Cost per KW installed	Rs. 2566	Rs. 2300

II. Cost of energy (KWH) at different stages

(a)	Between 10th & 30th years i.e. from commissioning to end of 20 years the reafter	9.1 P 8.3 P
(b)	Between 30th & 45th years i.e. from 20 to 35 years from commissioning	26.5 P 13 P
(c)	After 45 years i.e. 35 years after commissioning	29.3 P 18.2 P

NOTES: 1. Capital cost of Jalsindhi is as given in the updated project report Ex MR-137 (page iv—Vol. I)

2. Installed capacity for Jalsindi is as per EX MR-137 (page iv—Vol. I)

3. The energy generated at commencement and at final stage are as given in Ex MR-137 *vide* (page iv—Vol. I). The energy generated at 30 years from start (Stage II) is projected for the figures given in Annexure 16-2, Vol. II—Ex MR-137.

4. Capital cost of Sardar Sarovar FRL 455 is derived from the updated estimate for Sardar Sarovar FRL 530 *Vide* Ex G-1087 on the following basis—

   (a) Cost of dam and appurtenant works excluding land is worked out proportional to the square of the height of the dam upto MWL from the foundation level assumed as 5 ft.

   (b) Cost of land is worked out proportional to the area submerged upto MWL.

   (c) Cost of electrical installations including connected civil works is worked out proportional to installed generator capacity.

   (d) Capital cost in Stages II and III, takes into account the reduction afforded by amortisation of the cost of the River Bed Power House on the basis of the provision for amortisation in the cost structure of the energy.

5. The saleable energy is estimated as 95% of the energy generated in both Jalsindhi and Sardar Sarovar.

6. The annual cost of generation for different periods is estimated as 10% of the capital cost at the commencement of the stage.

7. The unit cost of energy for Jalsindhi for diflerent periods is worked out by dividing the annual cost vide para 6 above by the average annual number of saleable units in that period.

8. The unit cost of energy for Sardar Sarovar is also worked out as in 7 above but in the period upto commencement of Stage HI, an element to represent the amortisation of the capital cost of River Bed Power House is also added.

COST OF ENERGY/KWH AT SARDAR SAROVAR POWER COMPLEX AT DIFFERENT STAGES

1. Capital Cost

1. Civil Works at Unit 1—(Dam and appurtenant works allocable to power).

Total cost of Unit I dam and appurtenant works of Sardar Sarovar Dam—FRL = 530 as per up-dated estimate of Gujarat—G-1087 = 262.52 crores.

Assuming that the land value included in the above is proportional to the area, and that the cost of other items is proportional to the square of the height of dam above deepest foundation level.

Total cost of Unit 1—Dam and appurtenant works for Sardar Sarovar Dam with FRL 455 has been worked out as 163.44 crores as per details below :

(i) Cost of the dam at 460′ (excluding B land)

$$= \text{Cost of the dam } 540' \text{ (excluding B land)} \times \left[\frac{\text{Height of dam above foundation at } 460'}{\text{Height of dam above foundation at } 540'}\right]^2$$

$$= 202.68 \times \left[\frac{455}{535}\right]^2$$

$= 202.68 \times (0.85)^2$ $= \text{Rs. } 146.60 \text{ crores}$

(ii) Cost of B land @ 460′

$$= \text{Cost of B land @ } 530 \times \frac{\text{Submergence @ } 460}{\text{Submergence @ } 530}$$

$$= 59.84 \times \frac{92492}{328,678}$$

$= \text{Rs. } 16.84 \text{ crores}$

Total cost of the Dam at FRL 455′

$= 146.6 \times 16.84$

$= \text{Rs. } 163.44 \text{ crores.}$

As worked out in the chapter on allocation of cost of Sardar Sarovar Dam between irrigation and power, the cost allocable to power is 56.1% of Unit I Cost. This works to Rs. 91.69 crores(a)

2. Civil Works and Electrical works of Sardar Sarovar power complex

It is assumed that the cost of civil and electrical works (under Unit III power) in the canal and RBP Houses of Sardar Sarovar Dam will vary proportionately to the total installed capacity in the respective power houses.

As per G = 1087, the Canal Power House will have 9 machines of 75 MW each.

With 455 FRL and 9 MAF allocation to Gujarat, the maximum power developed in canal power house is about 110 MW at 100% LF., allowing LF between 30 and 40% and 1 spare machine, a provision of 5 units of 75 MW each will be adequate.

	Cost for 9M/c of 75 MW each as per G-1087	Prop. cost for 5 M/c of 75 MW each for the purpose of this study
	Rs. crores	Rs. crores
Civil works of Canal Power House	23.19	12.88
Electrical works	78.24	43.46
Miscellaneous	20.41	11.34
	121.84	67.68 (b)

With regard to the RBPH, the maximum power generated will be about 545 MW. This will vanish to 0 in 35 years (i.e. 45 years from start) and so the station will have to run as a base load station in the early stages and later work as a peaking station. Assuming that, provision is made for machine capacity to run the station at about 90% LF at commencement, we require 5 machines of 150 MW, including one spare machine. As in the case of the canal power house the pro rata cost is worked out below:—

	G-1087 10 M/c of 150 MW each	Prop. cost for 5 M/c of 150 MW each
	Rs. crores	Rs. crores
PH Civil works	30.32	
Electrical works	109.52	
Miscellaneous	45.32	
	185.16	92.58 (c)

NOTE: : In the case of the Canal PH, since the load develops progressively with irrigation, it is quite likely that the number of machines are gradually increased from a minimum of say 2 in the beginning. For the purpose of this note, the saving in interest and operating charges etc., on account of this progressive increase in capital, has been ignored and the total cost is taken into account from the very commencement.

The river bed power house will have no water for its operation when irrigation fully develops in the various States, i.e. in 45 years from start of construction. It is, therefore, proposed that an amount to cover the amortisation of the capital cost of this power house including civil and Electrical works be added to the unit cost of power developed in the Sardar Sarovar power Complex during that period. The actual increase in price per unit of energy to cover the amortisation mentioned here is worked out later in this annexure.

3. Transmission line from Sardar Sarovar Power Complex to Gujarat State border.

It is assumed that the capital cost of this may be Rs. 2 crores—(d)

4. It may, perhaps, be necessary to make some payment to Madhya Pradesh for regulated releases from Narmadasagar. As worked out in the Chapter on credit to Narmadasagar for regulated releases, a sum of Rs. 4.77 (e) crores is assumed as necessary for this purpose.

5. Total capital cost of Sardar Sarovar Power Complex will therefore, work out to :—

(a) 91.69 crores
(b) 67.68 „
(c) 92.58 „
(d) 2.00 „
(e) 4.77 „ or a total of Rs. 258.72 crores.

6. For working out the increase in the price of energy to cover amortisation of cost of River Bed Power House, the total cost has to be divided by the total energy sold till the PH becomes defunct. Since CHPH and RBPH are to be linked together, the total energy considered for this purpose will be the saleable energy from the two power houses from the 10th year from start to the 45th year from start.

	Canal Head PH	RBPH
Energy/year at 10 years from start	308 MU	4775 MU
Energy/year at 30 years from start	960 MU	1386 MU
Average	634 MU	3080.5 MU
Energy/year 45 years from start	960 MU	Nil
Average for 30—45 years	960 MU	693 MU
Total from 10 to 30 years	634×20	$+(3080 \times 20)$
	= 74280 MU	
Total from 30 to 45 years	960×15	$+(693 \times 15)$
	= 24795 MU	

Total for 10 to 45 years = 74280 + 24795 = 9907 5 MU

Assuming saleable energy as 95% of the above.

Total saleable energy—94121 M

Total amount to be amortised = 92.58 crores

$$\therefore \text{Addl. Cost per unit} = \frac{92.58 \times 10^7 \times 10^2}{94121 \times 10^6 \text{ paise}}$$

$$= 0.984 \text{ paise.}$$

7. In view of the amortisation there will be a progressive decrease in capital cost. Such decrease will be taken into account every time the unit price of energy is fixed. Though such fixation may be done at say five-yearly intervals or near about, it is assumed in this annexure that price refixation is made only at the commencement of Stage I, commencement of State II and commencement of Stage III

Capital cost at commencement of Stage 1 (10 years from start) = Rs.258.72 crores (h)

Capital cost at commencement of State II (30 years from start) = 258.72 crores—

$$\text{Rs. } \frac{95}{100} \times 74280 \times 0.984 \times 10^4$$

= Rs. 258.72—69.44 crores.

= Rs. 189.28 crores (i)

Capital cost at commencement of Stage III (45 years from start) = Rs. 258.72—92.53

= Rs. 166.14 crores (j)

8. The unit cost of energy (apart from the amortisation charge) will be the annual expenditure divided by the number of saleable units in the year.

The annual expenditure will include interest, depreciation, maintenance and operation charges and insurance. All these together can roughly be taken as 10% of capital cost. On this basis, the unit cost of energy (per KWH) during the different stages in Sardar Sarovar Power Complex works out as below :—

Between 10 and 30 Years From Start

Capital cost at commencement = Rs. 258.72 crores

Annual cost = 10% of Rs. 258.72 crores
= Rs. 25.87 crores

Average annual saleable energy $= \frac{95}{100} (634+3080.5) \times 106$ units
$= 3528.775 \times 10^6$ units

Cost per unit $= \frac{25.87 \times 10^8 \times 10^2}{3528.775 \times 10^6}$
= 7.331 paise

Add amortisation charge = 0.984 paise per unit

Total : = 8.315 paise per unit or 8.3 paise.

Between 30 And 45 Years From Start

Capital cost at commencement of the stage = 189.28 crores

Annual cost 10% = 18.93 crores

Average annual saleable energy $= \frac{95}{100}(960+693)$
= 1570.35 MU

Cost per unit $= \frac{18.93 \times 10^7 \times 10^2 \text{ Paise}}{1570.35 \times 10^6}$
= 12.055 paise

Add amortisation charge = 0.984 paise per unit

Total : = 13.032 paise per unit or say 13 paise per unit

After 34 Years From Start

Capital cost at commencement of the stage = Rs. 166.14 crores

Annual cost = Rs. 16.61 crores

Average saleable energy per year $= \frac{95}{100} \times 960$ MU
$= 912 \times 10^6$ units

Cost per unit $= \frac{16.61 \times 10^7 \times 10^2 \text{ paise}}{912 \times 10^6}$
= 18.21 paise or say 18.2 paise

COST OF ENERGY PER KWH IN JALSINDHI PROJECT

	Rs. crores
Total cost as per estimate (as per MR 137)	= 143.7 crores
Annual cost @ 10% (assumed)	= 14.37 crores
(a) Between 10 and 30 years of commencement of construction :	
Annual energy produced	
at commencement of Stage I	= 2707 MU
at end of 20 years after commissioning i.e. commencement of stage II	= 627 MU
∴ Average annual energy between stages I & II	$= \frac{2707+627}{1667^{a}}$ MU
Average annual Saleable energy	$= \frac{95 \times 1667}{100}$
	= 1584 MU
Average cost of energy for the Ist 20 years period (i.e. between stages I and II)	$= \frac{14.37 \times 10^{7} \times 10^{2}}{1584 \times 10^{6}}$
	= 9.07 paise, say, 9.1 paise
(b) Between 30 and 45 years of commencement of construction :	
Annual energy generated	
at 35th year after commissioning i.e. commencement of Stage III	= 516 MU per year (as per Project Report)
∴ Average annual energy generated between stages II & III	$= \frac{627+516 \text{ MU}}{2}$
	= 517.5 MU
Average annual saleable energy	$= \frac{95 \times 571.5}{100}$
	= 542.9 MU
Average cost of energy for the 15 years from stage II to stage III	$= \frac{14.37 \times 10^{7} \times 10^{2}}{542.9 \times 10^{6}}$
	= 26.46 paise
	say 26.5 paise
(c) After 45 years of commencement of construction :	
After Stage III i.e. after 35 years of commissioning	
Annual energy generation	= 516 MU
Average annual saleable energy	$= \frac{95}{100} \times 516$
	= 490.2 MU
Average cost of energy after III stage i.e. after 35 years	$= \frac{14.37 \times 10^{7} \times 10^{2}}{490.2 \times 10^{6}}$
	= 29.31 paise
	say 29.3 paise

CHAPTER XV

DOWNSTREAM BENEFITS

Question of Payment by Gujarat to Madhya Pradesh

15.1.1 In this Chapter, we propose to discuss the two related questions of (i) payment by Gujarat for any flood control benefits obtained by it due to construction of upstream reservoirs by Madhya Pradesh and (ii) payment by Gujarat for the benefits of regulated releases to be received by it from the upstream Narmada Sagar Project of Madhya Pradesh.

Issues 13 *and* 18

15.1.2 These questions form the subject matter of Issues 13 and 18 which are to the following effect :

"13. Should any directions be given

(a) for releases of adequate water by Madhya Pradesh below Narmada Sagar for the setting up and operation of Navagam Dam FRL 530/MWL 540 or thereabouts or less FRL/MWL ;

* * * *

(c) for releases by the State of Madhya Pradesh below Narmada Sagar for the benefits of the States of Gujarat and Maharashtra ;

(d) for the releases by the State of Madhya Pradesh below Narmada Sagar for the benefits of the State of Rajasthan.

"*Issue No.* 18. Whether the Navagam Project is liable to pay any compensation to any upstream project or projects in consideration of receiving regulated releases of the Narmada waters therefrom ? If so, how much and on what terms and conditions ?

Quantum and pattern of Regulated Releases

15.2.1 It has been agreed by the party States and decided by the Tribunal in its Order dated 8th October, 1974, that the utilisable quantity of water of 75 per cent dependability in the Narmada at Sardar Sarovar dam site should be assessed to be 28 MAF. The actual inflow of 75 per cent dependability, however, is only 27.01 MAF and this is brought up to utilisable quantity of 28 MAF by means of carryover in various reservoirs allowing for evaporation losses and regeneration. Out of 28 MAF, 9 MAF has to be provided for Gujarat and 0.5 MAF for Rajasthan at Sardar Sarovar. The requirements at Sardar Sarovar have to be met by releases by Madhya Pradesh and by inflows from the intermediate catchment, surplus to the requirements of Madhya Pradesh below Narmadasagar and Maharashtra. The releases from Maheshwar work out to 8.12 MAF as in paragraph 11.9.1 of Chapter XI on Height of Sardar Sarovar Dam. Making uniform monthly releases the amount of water to be released by Madhya Pradesh per month would be 0.677 MAF. The actual inflow in the river system, however, would vary from year to year and, therefore, the releases by Madhya Pradesh would also vary.

15.2.2 The inflow during the filling period, July to October, cannot be predicted at the beginning of the season. It is only in October that it would be fully known whether the particular year is a normal year or the extent to which it is a surplus or deficit year. Normally the releases by Madhya Pradesh during the filling period, therefore, would have to be more or less on the basis of the year yielding 28 MAF utilisable quantity. The month of July and early part of August are crucial for Kharif sowing. It is important that during this period regulatory arrangements should ensure that due share of water is made available to all parties.

15.2.3 Having regard to the facts mentioned in paragraphs 15.2.1 and 15.2.2, we order that detailed rules of regulation and water accounting shall be framed by the Narmada Control Authority (hereinafter referred to as the Authority) in accordance with the guidelines given below. These guidelines may, however, be altered, amended or modified by agreement between the States concerned.

(i) The 28 MAF utilisable supplies of 75 per cent dependability in a water year (1st July to 30th June next year) shall be shared by the party States as under :—

Madhya Pradesh	—	18.25 MAF
Gujarat	—	9.00 MAF
Rajasthan	—	0.50 MAF
Maharashtra	—	0.25 MAF
		28.00 MAF

(ii) Surplus or deficit utilisable supplies in a water year shall be shared to the extent feasible by the party States in the same proportion as their allotted shares in (i) above.

(iii) The water available in the live storages of the various reservoirs on 30th June shall be reckoned as an inflow to be shared in the next water year.

(iv) The releases necessary to ensure Gujarat and Rajasthan's share of water in a water year shall be let down by Madhya Pradesh at a reasonably uniform rate, permitting only such variation as the Authority may direct or approve and keeping in view the directions for regulated releases.

(v) The Authority shall ensure by so directing the releases by Madhya Pradesh that there is at all times sufficient utilisable water in Sardar Sarovar to meet the requirements of the next ten days. For this purpose, Gujarat and Rajasthan would intimate their requirements of the 10 daily period well in advance.

(vi) Utilisation in a water year by each party State shall be figured out on the basis of actual daily discharge at canal head on every major and medium project. For minor works, it shall be on the basis of area irrigated under different crops, the delta for each crop being approved by the Authority. For pumping schemes, drawing directly from the river, its tributaries or reservoirs, whether for irrigation, domestic or industrial use, water drawn shall be reckoned on the basis of the rated capacity of pumps and the number of hours they run. For a cross check, the season-wise and crop-wise area irrigated by each pumping scheme shall also be recorded, and if the figures of water drawn as worked out by the two aforesaid methods differ, the decision of the Authority as regards water drawn shall be final.

(vii) Withdrawals from Sardar Sarovar for Navagam Canal for Gujarat and Rajasthan shall be measured at the head of Navagam Canal. The supply to Rajasthan shall be measured at Gujarat-Rajasthan border. The loss in the canal in carrying the supply for Rajasthan shall be determined by the Authority after the canal has been constructed and shall reckon against the share of Rajasthan.

Water let down into the river from Sardar Sarovar through power house turbines shall be measured on the basis of power generated by it and that escaped through the spillway by measurement at the spillway.

Gujarat may let down water from Sardar Sarovar for its downstream use by making specific indent for it and such releases shall reckon against its share. Such releases for downstream use shall be made through the turbines and the power so generated shared between Madhya Pradesh, Maharashtra and Gujarat in the prescribed ratio. Water let down into the river from Sardar Sarovar except at the specific indent of Gujarat shall not reckon against the share of Gujarat.

(viii) For major and medium projects, water account shall be kept by 10 daily period. The last 10 daily period of a month may have 11 days, 10 days or less, depending upon the number of days in the month. For minor schemes water accounts shall be kept by crop seasons, kharif (July to October), rabi (November to March) and hot weather (April to June). For pumping schemes and domestic and industrial uses it shall be monthly.

(ix) The water use by minor and pumping schemes in any ten daily period may provisionally be taken to be the same as in the corresponding period in the previous year on the basis of average use during the crop period. For final water account, however, it will be determined as in (vi) above.

(x) Each State shall furnish to the Authority and make available to any party State desiring the same, such data and information as the Authority may require and ask for.

(xi) The Authority shall arrange the review of the ten day releases made by Madhya Pradesh at least once a onth and oftener as considered necessary for directing any change in the releases. It may designate a person for doing so.

(xii) The Authority shall direct final adjustment to be made in the following water year of the use in excess of the authorised use, if any, by any State or States during the preceding water year by curtailing the share(s) of the State or States concerned which have used water in excess and make over the same to the State or States which have received short supplies. Water supplied to Rajasthan on any day in excess of 10 per cent over and above its indent shall reckon against use by Gujarat.

(xiii) The Authority shall furnish the annual water account for the water year to the Government of the party States by the end of August of the next water year. Each State may make any observation on the account and/or point out corrections in it, if any, within one month of its receipt. After making the necessary modifications, the Authority shall furnish to each party State the final annual water account for the water year by 31st October. The Authority shall cause the annual water account to be published each year.

Contribution to Madhya Pradesh for Regulated Releases

15.3.1. *Claims of Madhya Pradesh and Gujarat* : It is the case of Madhya Pradesh that Gujarat is bound to make a contribution to Madhya Pradesh for benefits like regulated releases and flood moderation derived by Sardar Sarovar Project from Narmadasagar Project and other upstream projects located in Madhya Pradesh. In its comments on the Khosla Committee Report (MP-165), Madhya Pradesh pointed out that the provision of Rs. 13 crores recommended by the Khosla Committee for the downstream benefits was totally inadequate and no account has been taken of the flood control or irrigation benefits derived by Gujarat from upstream projects. The argument of Madhya Pradesh is that Gujarat must contribute "half the additional power generated due to regulated releases or else money value for the additional power" and as regards the irrigation bene-

fits, "Gujarat must give half the revenue derived by it from the levies such as water rates, betterment levy etc. on account of regulated releases. In the alternative, Madhya Pradesh must be credited with the amount that will be saved by Gujarat in the construction of Navagam Dam as a result of these regulated releases." As regards flood moderation, Madhya Pradesh claims that Gujarat must pay "half the money value of the annual damages saved in Gujarat" or alternatively the flood control component of the Sardar Sarovar Dan. as finally decided upon.

In CMP 254 of 1975, Gujarat stated that it was not liable to pay any compensation to Madhya Pradesh either for flood moderation or for regulated releases from Narmadasagar Project.

Report of the International Joint Commission 1959

15.3.2 The question of sharing the downstream benefits was a matter of serious controversy between the United States of America and Canada over the development of the waters of Columbia River. Canada contended that Canadian land was used for the storage of water and that Canada should be entitled to downstream benefits in the form of power or flood protection. But the United States resisted this argument. The United States refused to discuss compensation beyond the value of the land and the cost for clearing the land and the relocating of roads, railroads, and oustees. The matter was referred to the International Joint Commission in January, 1959 by both the States with the request that a special report be made recommending how the benefits arising from the co-operative development should be calculated and how they should be apportioned. On 29th December, 1959, the International Joint Commission submitted a report which represented a major step towards the formal recognition that the upstream State had a right to a share of the downstream benefits of its storage provided that it was willing to operate that storage in a pre-determined manner.

15.3.3 The principles proposed by the Commission contain the following major recommendations :—

(1) Power Principles :

(1) "Downstream power benefits in one country should be determined on the basis of an assured plan of operation of the storage in the other country.

**** **** ****

(6) "The power benefits determined to result in the downstream country from regulation of flow by storage in the upstream country should be shared on a basis such that the benefit, in power, to each country will be substantially equal, provided that such sharing would result in an advantage to each country as compared with alternatives available to that country, as contemplated in General Principle No. 2. Each country should assume responsibility for providing that part of the facilities needed for the co-operative development that is located within its own territory. Where such sharing would not result in an advantage to each country as contemplated in General Principle No. 2, there should be negotiated and agreed upon such other division of benefits or other adjustments as would be equitable to both countries and would make the co-operative development feasible."

**** **** ****

15.3.4 Flood Control Principles

"(1) Flood Control benefits should be determined on the basis of an assured plan of operation and flood control regulations agreed to in advance.

**** **** ****

(4) The upstream country should be paid one-half of the benefits as measured in Flood Control Principle No. 3, i.e. one-half of the value of the damages prevented."

**** **** ****

Columbia River Basin Treaty 1967

15.3.5 These principles found acceptance in the Columbia River Basin Treaty dated January 17, 1961. By giving to Canada half the power generated in the United States with the help of Canadian storage facilities, the Treaty expressly accepted the downstream benefit theory. Since Canada might not have a ready market for the additional power, the Treaty permitted it to be sold to the United States under conditions to be determined by future agreement. The Canadian storage facilities of 15.5 million acre feet, for both power and flood control, are to be provided by constructing dams at Mica Creek, near the outlet of Arrow Lake and on tributaries of the Kootcney River. The United States undertook to operate its power facilities in the most efficient manner, and to pay Canada for flood control measures made possible by Canadian storage facilities.

15.3.6 Article V of the Treaty states :—

"Article V—Entitlement of Downstream Power Benefits :

(1) Canada is entitled to one half of the downstream power benefits determined under Article VII.

(2) The United States of America shall deliver to Canada at a point on the Canada—United States of America boundary near Oliver, British Columbia, or at such other place as the entities may agree upon, the downstream power benefits to which Canada is entitled....."

15.3.7 Article VI provides for the payment for flood control and states :—

"Article VI—Payment for Flood Control :

(1) For the Flood Control provided by Canada under Article IV(2)(a) the United States of America shall pay Canada in United States funds :

(a) 1,2000,000 dollars upon the commencement of operation of the storage referred to in sub-paragraph (a) (i) thereof, and

(b) 52,100,000 dollars upon the commencement of operation of the storage referred to in sub-paragraph (a)(ii) thereof ; and

(c) 11,100,000 dollars upon the commencement of operation of the storage referred to in sub-paragraph (a)(iii) thereof."

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(3) For the flood control provided by Canada under Article IV (2)(b) the United States of America shall pay Canada in United States funds in respect only of each of the first four flood periods for which a call is made 1,875,000 dollars and shall deliver to Canada in respect of each and every call made, electric power equal to the hydro-electric power lost by Canada as a result of operating the storage to meet the flood control need for which the call was made, delivery to be made when the loss of hydro-electric power occurs."

Federal Power Act, 1935

15.3.8 The principle of payment for downstream benefits is also enacted in section 10(f) of the Federal Power Act, 1935 (41 Stat. 1063 amended by 49 Stat. 843—44=16 U. S. C. 803 (f) which imposes on the Federal Power Commission the duty of determining the benefits of downstream plant due to upstream storage and of assessing charges against those downstream plants. Section 10(f) reads as follows :

"(f) Whenever any licensee hereunder is directly benefited by the construction work of another license, a permittee, or of the United States of a storage reservoir or other headwater improvement, the Commission shall require as a condition of the licence that the licensee so benefited shall reimburse the owner of such reservoir or other improvements for such part of the annual charges for interest, maintenance, and depreciation thereon as the Commission may deem equitable. The proportion of such charges to be paid by any licensee shall be determined by the Commission. The licensees or permittees affected shall pay to the United States the cost of making such determination as fixed by the Commission.

Whenever such reservoir or other improvement is constructed by the United States the Commission shall assess similar charges against any licensee directly benefited thereby, and any amount so assessed shall be paid into the Treasury of the United States, to be reserved and appropriated as a part of the special fund for headwater improvements as provided in section 810 of this title.

Whenever any power project not under licence is benefited by the construction work of a licensee or permittee, the United States or any agency thereof, the Commission, after notice to the owners or owners of such unlicensed project, shall determine and fix a reasonable and equitable annual charge to be paid to the licensee or permittee on account of such benefits, or to the United States if it be the owner of such headwater improvement."

15.3.9 The principle of payment for downstream benefits is also expressed in several inter-State compacts. Article III, paragraph (c) of the Canadian River Compact 1950, reads thus :

"That the constructed works for the beneficial use of the waters in the Signatory States (and the districts therein) shall be designed, and constructed to carry water to the lower States and districts wherever practical if requested by such lower States and districts and shall be and may be used by said lower States and districts therefor to such extent within the quantities of water allocated to the respective States and districts as provided in paragraph (a) of this Article and within their capacity as may be practicable; the extra cost of said construction over local necessities, if any, to be determined and fixed by the Commission in charge and such extra costs shall be assumed by such lower States and districts respectively....."

Article IV(1)(p) of the Delaware River Basin Compact, 1961, states as follows :—

"IV(1). For the effectuation of its authorised purposes, the Commission is hereby granted and shall have the following powers in addition to such powers as may be provided for elsewhere in this compact, to wit :

*** *** ***

(p) To make, enter into, and perform contracts with the Federal Government, with any of the signatory States or any of their political sub-divisions with public or private agencies, and with corporations or individuals, including (1) contracts for the sale of water for water supply, for the sale of falling water and hydro-electric power and energy, subject to the provisions of Article X, or for other services, (2) contracts for payment by the signatory States, or the political sub-divisions thereof, for benefits resulting from water released from storage in order to maintain an adequate minimum flow in the Delaware River during periods of low flow therein, and (3) any other contracts necessary or incidental to the performance of its duties and the execution of its powers under this compact."

Article IV(4) of the Snake River Compact, 1949, provides :—

"4. That whenever citizens of either State shall undertake to construct reservoirs on Salt River or its tributaries in the 'South Fork Section' to provide water for lands in either State and it shall be practicable to extend the benefits of such storage to lands within the

watershed of Salt River other than the land specified in the application for permit originally filed, the owners of such other lands as might be benefited shall have the right to participate in the benefits of such reservoirs, by assuming their proportionate share of the cost of construction, operation and maintenance of such reservoirs prior to starting construction."

River Boards Act, 1956

15.3.10 The same principle is recognised in Indian Law. Section 15(4) of the River Boards Act, 1956 (Act 49 of 1956) States :—

15(4). "*Preparation of schemes by Board and their Execution* : Before any scheme is approved, the Board shall take into account the costs likely to be incurred in undertaking measures for executing the scheme and in maintaining any works to be undertaken in the execution of the scheme and the costs shall be allocated among the Governments interested in such proportion as may be agreed or, in default of agreement, as may be determined by the Board having regard to the benefits which will be received from the scheme by them."

Section 22 of the same Act reads as follows :—

22(1). *Arbitration* : Where any dispute or difference arises between two or more Governments interested with respect to—

*** *** ***

(d) the sharing of benefits or financial liabilities arising out of any advice tendered by the Board; any of the Governments interested may, in such form and in such manner as may be prescribed, refer the matter in dispute to arbitration.

*** *** ***

22(4). The decision of the arbitrator shall be final and binding on the parties to the dispute and shall be given effect to by them.

15.3.11 By its letter No. 1(7)/60-Policy, dated 7th August, 1961, the Government of India appointed a Committee under the chairmanship of Shri Yadav Mohan to examine the question of levying of charges for utilisation of water on a downstream project, whether in the same or another State. (See its report MP/733). The Committee made the following recommendations :—

"When an upstream project is constructed later than an existing downstream project, the latter shall be liable to pay for the benefits obtained from an upstream project irrespective of the period that has elapsed after its construction, but when the downstream project is constructed after the upstream project, the downstream project need pay for the benefits received only if it is conceived within 20 years of completion of the upper project.

"In either case the charge will be borne only if it is clearly established that the downstream project has been benefited by the changes in flows or otherwise by the construction or operation of the upstream project. "The lower Project will bear the cost to the extent the actual additional benefits are made available to it and as and when these benefits actually accrue."

Principle Applicable

15.4.1 We consider that the principle of payment for downstream benefits somewhat similar to that recognised by the United States of America—Columbia Treaty of 1961 applies in the present case. It follows, therefore, that as a matter of law, Madhya Pradesh is entitled to payment for downstream benefits (i) for regulated releases of Narmada waters from Narmadasagar Project for the beenfit of Sardar Sarovar Dam and (ii) for flood control benefits, if any, obtained by Gujarat due to construction of upstream reservoirs in Madhya Pradesh. We shall now proceed to indicate how the principle is to be worked out in the present case.

The Concerned Projects

15.5.1 *Naramadasagar (Punasa) Project* : The Narmadasagar Project Report, April 1969, Exhibit MP-158 envisages construction of a dam at Punasa with FRL +860 and MWL +864. The Narmadasagar reservoir will have a gross storage capacity of 9.9 MAF and live storage capacity of 7.9 MAF, thereby providing a dead storage of 2.0 MAF at RL +798. The Main Canal will command a culturable area of 3.63 lakh acres of which 3.00 lakh acres is to be irrigated. An annual irrigation of 6.18 lakh acres is contemplated. The project is designed to conserve the entire inflow reaching Narmadasagar from its catchment area of 23,800 square miles, although only a fraction of it is required for irrigation use. With the regulated releases from the reservoir, a large block of power is proposed to be generated at Narmadasagar, Omkareshwar and Maheshwar dams. The project is power oriented.

15.5.2 The Narmadasagar Dam is designed for a design flood of 23.02 lakh cusecs. The Project Report stipulates that until the incoming flood exceeds the discharging capacity of the spillway, the water level in the reservoir will be maintained at FRL and the flood to be passed through will be regulated by opening of the crest gates, *vide* Exhibit MP-158, Volume II, p. 74. With higher floods, the reservoir level would rise from FRL +860 to a maximum level of +864 and the floods would get moderated in the process.

15.5.3 *The Omkareshwar Project* : The Omkareshwar dam site is only 34 miles downstream of Narmadasagar dam site. In the Omkareshwar Project Report, 1972, Exhibit MP-323, an annual irrigation of 6,63,810 acres in a command area of 3,63,700 acres is proposed. The reservoir will have a live storage of 0.658 MAF. The inflow from the catchment area of 1,250 square miles between the Narmadasagar and Omkareshwar dam is 0.60 MAF of which 0.55 MAF is in the

filling period and 0.05 MAF in the non-filling period. As this is not sufficient to meet the irrigation requirement of the project, supplemental supplies are to be made available from Narmadasagar. The salient levels are FRL +660, MWL +665 and average TWL +534.

15.5.4 *The Maheshwar Project*: The Maheshwar dam is only a lift dam for generation of hydro-electric power and serves no other purpose. The reservoir has a small live storage capacity of 0.023 MAF. The catchment area between Omkareshwar and Maheshwar dams is 1662 square miles and the inflow from it is about 1.6 MAF. The salient levels are FRL +534, MWL +541 and average TWL +457.

15.5.5 *The Sardar Sarovar Project*: It is proposed that Sardar Sarovar dam should be built with FRL +455 and MWL +460. The Navagam Canal is to have a FSL of +300 at its head for which a minimum reservoir level of +307 would be required. From consideration of power generation, however, the MDDL would be +363. The reservoir will have a live capacity of 4.43 MAF above MDDL +363. The water use envisaged is 9 MAF in Gujarat and 0.5 MAF in Rajasthan. The evaporation from the reservoir is expected to be 0.5 MAF. Thus for a year of 75 per cent dependable use, the water requirement at Sardar Sarovar is 10 MAF.

Benefit from Regulated Releases

15.6.1 It is obvious from the Master Plan of Madhya Pradesh, Exhibit MP-312, that it planned a large reservoir at Narmada-sagar, in order to derive maximum power benefit from Narmadasagar, Omkareshwar and Maheshwar projects. Sardar Sarovar Project also would derive considerable benefit from these regulated releases. Without regulated releases it would not be possible to utilise the full share of water allotted to Gujarat with Sardar Sarovar FRL+455. The benefit which regulated releases from Narmadasagar FRL+860 would confer on Sardar Sarovar can be assessed by—

(i) determining the quantity of water that would be unavailed at Sardar Sarovar in the absence of regulated releases and the consequent loss of irrigation and power; or

(ii) the extra cost that would have to be incurred in providing a larger storage at Sardar Sarovar to prevent this loss of irrigation and power.

Narmadasagar without Regulated Releases

15.6.2 Narmadasagar during the filling period, July to October, the inflows would be in excess of the irrigation requirement there to the extent of 6.91 MAF. Even during the non-filling period, there would be a surplus of 1.172 MAF (Statement 15.1). These surpluses are to be stored at Narmadasagar for regulated releases during November to June.

15.6.3 At Omkareshwar, with no regulated releases from Narmadasagar, there would be no power generation for 6 months during the non-filling period as there would be no outflow from Omkareshwar reservoir. Likewise there would be no power generation at Maheshwar for six months during the non-filling period.

15.6.4 Without regulated releases from Narmadasagar, Sardar Sarovar FRL +455 will not be able to utilise its allotted share of water as a good deal of flood flows would spill down to sea instead of being stored at Narmadasagar for regulated releases. Due to the spillage and lack of carryover capacity there would be a loss of 17.8 per cent in irrigation and power benefits at Sardar Sarovar, as worked out in Statement 15.2.

15.6.5 The loss of irrigation and power at Sardar Sarovar FRL +455 accruing due to unregulated flow from Narmadasagar can be prevented by building a higher dam at Sardar Sarovar to store the water which otherwise would go to waste. The levels in that case would be FRL +490 and MWL +492 as worked out in Statement 15.3.

15.6.6 If Sardar Sarovar dam is built to FRL +490 and MWL +492 in order to prevent the loss of benefits arising out of unregulated flow from Narmadasagar, the cost of the dam would be about Rs. 202.35 crores against Rs. 163.44 crores for FRL +455, as in Statement 15.4. The increase in cost over that for FRL +455 would be of the order of Rs. 38.91 crores (Rs. 202.35—163.44 crores). This can be looked upon as a measure of benefit due to regulated releases from Narmadasagar. However, because of higher head available in this case, there would be some increase in power generation.

Flood Moderation

15.7.1 In regard to Madhya Pradesh's claim for payment for flood moderation which its dams would provide in Gujarat, Gujarat argued that it has not demanded that Madhya Pradesh should reguiate Narmada flows for Gujarat **vide** Gujarat's Written Submission 8A, p. 140. It stated that "flood control storage between FRL and is a temporary uncontrolled storage resulting from the fact that the outflow capacity of the spillway is below the rate of inflow during spillway design flood or corresponding high flood. This results in temporay raising of the reservoir level which goes down as the flood passes." Ibid pp. 151-152. It further stated that "if the outflow from such storage synchronises with flood emanating in the intervening reach the flood hazard to downstream area gets aggrated." Ibid p. 153-A. It pointed out that "flood control was not mentioned as a purpose to be aimed at in the Master Plan." Ibid. p. 158.

15.7.2 The High Level Committee on Floods, set up by the Government of India in 1957, observed in its report* that "to be effective a reservoir must have adequate capacity set apart exclusively for flood control purposes, and this means an extra height of the dam specifically for this purpose...Multipurpose reservoirs, however, where not specifically designed to cater for flood control can have, and in most cases do have, appreciable flood control benefits, inasmuch as the early floods when the reservoirs are generally low get absorbed or moderated. These reservoirs may not afford relief towards the latter part of the season when they are more or less full".

*Report of High Level Committee on Floods (1957) Vol. I, p. 55 para 6.2.4.

15.7.3. Madhya Pradesh has not provided any space in any of its reservoirs for the exclusive purpose of flood moderation. Nor has it undertaken to operate them in the interest of flood control. The Narmadasagar Project does not cater for any flood regulation and the moderation that takes place when the reservoir level rises above FRL is unregulated. The benefit is incidental and Madhya Pradesh would be incurring no cost or inconvenience in this regard to justify its claim for any payment for it.

Payment by Sardar Sarovar of Narmada-Sagar

15.8.1. By building Narmadasagar dam with FRL +860, thereby conserving inflows of the filling period and providing regulated releases from it, both Madhya Pradesh and Sardar Sarovar benefit. The former gets increased power and the latter saves considerable quantity of water for both power generation and irrigation. Narmadasagar project is basically a power project which provides irrigation as a minor benefit. The dam enables use of 4.525 MAF for irrigation and 8.817 MAF for power as per Statement 15.5. Apportioning the cost of the dam of Rs. 95.38 crores at 1975-76 prices as given in Exhibit MP-1056 of 1977, by use of facility method (actual water used), the cost chargeable to power would be Rs. 63.03 crores *vide* Statement 15.5. Narmadasagar dam enables generation of large blocks of power at Narmadasagar, Omkareshwar and Maheshwar and contributes to increased power generation at Sardar Sarovar. The extent of power thus generated at each is given in Statement 15.5. The power component of cost of Narmadasagar, Rs. 63.03 crores, is distributed proportionally between these projects. The share of Sardar Sarovar of the power cost works out to Rs. 4.77 crores.

15.8.2. Narmadasagar also contributes to incrased irrigation benefit at Sardar Sarovar to the extent of 17.8 per cent. The irrigation component of cost of Narmadasagar, Rs. 32.35 crores, is apportionable between Narmadasagar, Omkareshwar and Sardar Sarovar. The share of Sardar Sarovar would be Rs. 12.05 crores, *vide* Statement 15.5.

15.8.3. The total amount chageable to Sardar Sarovar would thus be Rs. 16.82 crores (4.77+12.05) out of the estimated cost of Narmadasagar dam—Unit I—of Rs. 95.38 crores at 1975-76 prices. This is 17.63 per cent of the cost of Narmadasagar dam. As shown in Statement 15.4, in the absence of regulated releases, Sardar Sarovar would have to incur an expenditure of Rs. 38.91 crores to get the same benefits. The share cost creditable to Narmadasagar for regulated releases is less than this amount. As the actual cost of construction of Narmadasagar would be different from the estimated cost, it would be appropriate to determine the amount to be credited as percentage of the expenditure. We, therefore, conclude that Sardar Sarovar should credit to Narmadasagar each year 17.63 per cent of the expenditure in the financial year commencing from the year of taking up of the construction of Narmadasagar Dam. This will be initially credited on the basis of budget allotment to be adjusted at the end of the year on actual expenditure. The post construction expenditure on maintenance is not to be considered as cost of construction.

15.9.1. Issues 13 and 18 are answered accordingly.

10.10.1. We have consulted our assessors Dr. M.R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this chapter. They all advise us that they agree with the conclusion reached in paragraph 15.8.3 and the reasoning given by us for reaching that conclusion.

STATEMENT 15.1

MONTHLY WORKING TABLE FOR NARMADASAGAR FOR MEETING IRRIGATION REQUIREMENT IN MADHYA PRADESH
(For 75 per cent dependable use)

Figures in MAF

Month	NARMADASAGAR								OMKARESHWAR				
	Water requirement	Evaporation loss	Total requirement (2+3)	River inflows	Regenerated inflow	Use by medium minor micro-minor & pumping schemes	Net inflows (5+6—7)	Water available for down-stream use (8—4)	Water requirement	Evaporation loss of Omkareshwar less regeneration	Total water requirement (10+11)	Inflows between Narmadasagar and Omkareshwar	Water available at Omkareshwar (9+13—12)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
July to October . . .	0.394	0.216	0.610	13.172	0.456	6.110	7.518	6.908	0.324	0.048	0.372	0.552	7.088
November	0.216	0.045	0.261	0.719	0.126	0.028	0.817	0.556	0.162	0.009	0.171	0.016	0.401
December	0.141	0.045	0.186	0.403	0.159	0.028	0.534	0.348	0.127	0.009	0.136	0.008	0.220
January	0.197	0.045	0.242	0.288	0.111	0.028	0.371	0.129	0.162	0.009	0.171	0.006	(—)0.036
February.	0.142	0.054	0.196	0.201	0.158	0.028	0.331	0.135	0.133	0.011	0.144	0.004	(—)0.005
March	0.130	0.080	0.210	0.173	0.128	0.028	0.273	0.063	0.155	0.016	0.171	0.001	(—)0.104
April	0.082	0.119	0.201	0.144	0.049	0.028	0.165	(—)0.036	0.155	0.020	0.175	0.004	(—)0.207
May	0.122	0.120	0.242	0.086	0.035	0.028	0.093	(—)0.149	0.175	0.028	0.203	0.002	(—)0.350
June	0.140	0.064	0.204	0.287	0.071	0.028	0.330	0.126	0.168	0.018	0.186	0.006	(—)0.054
Sub-Total November to June .	1.170	0.572	1.742	2.301	0.837	0.224	2.914	1.172	1.237	0.120	1.357	0.050	
Total for the year . . .	1.564	0.788	2.352	15.473	1.293	6.334	10.432	8.080	1.561	0.168	1.729	0.602	

NOTES :

1. In the absence of storage at Narmadasagar, there would be shortage at Omkareshwar during January to June (Column 14) aggregating to 0.756 MAF say 0.76 MAF. Live storage to this extent has, therefore, to be provided at Narmadasagar to meet the irrigation requirements at Omkareshwar.
2. There would be a surplus in November and December at Omkareshwar as in column 14 aggregating to 0.621 MAF which would be available for Sardar Sarovar.

Explanatory notes on columns of monthly working table for Narmadasagar for meeting irrigation requirements in Madhya Pradesh for 75 percent dependable use

Column 2 — Water requirement : It includes irrigation, industrial and domestic requirement. Figures for irrigation requirement have been taken as mean of that for allocation of 19.25 and 17.25 MAF in Exhibits MP-808 and MP-809.
Figures for industrial and domestic use have been taken from Exhibit MP-1008 and distributed uniformly over the year.

Column 3 — Evaporation loss : This has been calculated on the basis of rate of monthly reservoir loss indicated in the Project Report MP—158, Vol. I, p. 39.

Column 5 — River inflows : Inflow from free catchment in non-filling period has been taken from MP-871 and its monthly distribution made as per average percentage inflow actually observed in 19 years given in Project Report MP-158, p. 31. For filling period the inflows have been so worked out as to give regulated releases of 8.08 MAF downstream of Narmadasagar in the final stage.

Column 6 — Regenerated inflow : This is taken as 10% of irrigation use in the upstream major, medium and minor projects and 60% of the water used for industrial and domestic use with a lag of one month. Figures of regeneration have been taken from MP-1008, and of water use from MP-808 and 809.

Column 7 — Use by medium, minor, micro minor and pumping schemes : Taken from MP-1007. Considered 50% of upstream use.

Column 10 — Water requirement of Omkareshwar : It includes industrial and domestic use, estimated from use for major projects below Narmadasagar for allocation of 18.25 MAF.

Column 11 — Evaporation loss of Omkareshwar less regeneration : Taken from Working Table of Omkareshwar Project for final phase *vide* MP-359, p. 204.

Column 13 — Inflow between Narmadasagar and Omkareshwar : This is taken from MP-323, Vol. I, p. 22 for 75% dependable flow.

STATEMENT 15.2

REDUCTION IN BENEFITS FROM SARDAR SAROVAR FRL+455 WITHOUT REGULATED RELEASES FROM NARMADASAGAR

Out of a 75 per cent dependable utilisation of 28 MAF, Sardar Sarovar is to get 9.5 MAF for use by Gujarat and Rajasthan. With an evaporation loss of 0.50 MAF, the requirement there is 10.00 MAF. This would be possible by providing a carry-over capacity.

In the absence of any carry-over capacity, Gujarat and Rajasthan would be entitled to their proportionate share amounting to 9.16 MAF (8.68+0.48) out of a 75 per cent dependable flow of 27.01 MAF. After deducting evaporation loss of 0.50 (0.15 during filling period and 0.35 during non-filling period) water available to Gujarat and Rajasthan would be 8.66 MAF (9.16—0.50) as against a share requirement of 9.5 MAF of 75 per cent dependable use, that is, 91.1 per cent of the requirement. Of 8.66 MAF, the irrigation use during the filling period would be 2.86 MAF (3.01—0.15) the same as for a use of 9.5 MAF. The inflow into Sardar Sarovar during the non-filling period would be 0.52 MAF, comprising 0.17 MAF from the free catchment and 0.35 MAF of regeneration inflow. Allowing for this inflow the live storage requirement at Sardar Sarovar would be 5.28 MAF (8.66—2.86—0.52).

The gross storage capacity of Sardar Sarovar at FRL+455 is	7.70 MAF
Dead storage (MDDL+363)	2.97 MAF
Silt reserve in live storage	0.30 MAF
	3.27 MAF
Net live capacity (7.70—3.27)	4.43 MAF

This capacity being short of the required 5.28 MAF, there would be spill of 0.85 MAF (5.28—4.43) from the available usable quantity of 8 66 MAF Therefore, against 9.5 MAF use, Sardar Sarovar gets 7.81 MAF (8.66—0.85), that is 82.2%. Thus there is a reduction or 17.8% in the benefits of Sardar Sarovar.

STATEMENT 15.3

STORAGE REQUIREMENT OF SARDAR SAROVAR WITHOUT REGULATED RELEASES

(1) Water requirement (including for Rajasthan and evaporation loss)	
(i) Filling period	3.01 MAF
(ii) Non-filling period	6.99 MAF
TOTAL	10.00
(2) Live Storage Requirement	
(i) Requirement of non-filling period	6.99 MAF
(ii) Inflow in non-filling period from Omkareshwar (Statement 15.1)	
November 0.40	
December 0.22	
(iii) Inflow in non-filling period from catchment below Omkareshwar 0.11	0.73 MAF
Net required	6.26 MAF
(3) Carry-over capacity	
(i) Required for the entire system	8.29 MAF
(ii) Share of Madhya Pradesh proportionate to water use	5.48 MAF
	2.81 MAF
(4) Storage Requirement	
(i) Dead storage for MDDL+375 corresponding to FRL+490	3.33 MAF
(ii) Silt storage in live capacity	0.40 MAF
(iii) Live storage	6.26 MAF
(iv) Carry-over capacity	2.81 MAF
TOTAL	12.80 MAF

(5) The flood cushion between FRL+455 and MWL+460 is 0.43 MAF. Providing the same in the present case, the capacity at MWL becomes 13.23 MAF corresponding to RL+492. The levels, therefore, are

FRL+490
MWL+492

STATEMENT 15.4

COST OF SARDAR SAROVAR DAM

Gujarat, in its Exhibit No. G/1087 has furnished revised costs of Sardar Sarovar for FRL 530' and MWL 540' based on the 1975-76 prices. In these estimates cost of dam has been shown as Rs. 262.52 crores, including cost of B-Land. Cost of B-Land at 530' has been shown as Rs. 59.84 crores. On the basis of these costs, the costs of dam with FRL 455 and FRL 490 have been worked out below :—

(1) Cost of dam with FRL 455 and MWL 460 Height of dam upto MWL above foundation . . . =460—5=455 ft.

Cost of dam excluding B-land for FRL 455

$$202.68 \times \left(\frac{455}{535}\right)^{4} \quad \text{. . . . . =Rs. 146.60 crores}$$

Cost of B-land upto MWL 460

$$59.84 \times \frac{92,492}{3,28,678} \quad \text{. . . . . =Rs. 16.84 crores}$$

Total cost of dam FRL+455 . . . . . =Rs. 163.44 crores

(2) Cost of dam with FRL 490 and MWL 492

Height of dam upto MWL above foundation . . . . . =492—5=487 ft.

Cost of dam excluding B-land FRL 490

$$202.68 \times \left(\frac{487}{535}\right)^{4} \quad \text{. . . . . =Rs. 167.94 Crores}$$

Cost of B-land upto MWL 492

$$59.84 \times \frac{1,89,000}{3,28,678} \quad \text{. . . . . =Rs. 34.41 crores}$$

Total cost of dam FRL+490 . . . . . =Rs. 202.35 crores

Therefore the difference in the cost of the dam with FRL 490 and FRL 455 is (202.35—163.44) . . =Rs. 38.91 crores

NOTE :—Land is to be acquired upto FRL and properties between FRL and MWL. However, as values of properties are not known, for the present purpose submergence upto MWL has been considered.

STATEMENT 15.5

CREDIT BY SARDAR SAROVAR FOR REGULATED RELEASES FROM NARMADASAGAR

1. Water used for irrigation

The use includes that for industrial and domestic purposes :

(a) Requirement at Narmadasagar vide Statement 15.1 . . . . . 1.564 MAF

Downstream releases used for power . . . . . 8.08 MAF

Evaporation loss (MP—158 Vol. I, p.36) . . . . . 0.88 MAF

Distributing the evaporation loss between irrigation and power use, loss pertaining to irrigation is

$$\frac{1.564 \times 0.88}{8.08 + 1.564} = 0.143 \text{ MAF}$$

(b) Use at Omkareshwar would be total requirement minus inflow between Narmadasagar and Omkareshwar

Total requirement . . . . . = 1.561 MAF

Evaporation . . . . . = 0.168 MAF

1.729 MAF

Inflow . . . . . = 0.602 MAF

1.127 MAF 1.127 MAF

(c) Irrigation use at Sardar Sarovar is 9.5 MAF. Taking 17.8% of this, the use attributable to Narmadasagar is $9.5 \times \frac{17.8}{100}$ . . . . . 1.691 MAF

Total water use for irrigation . . . . . 4.525 MAF

2. Water used for power

Downstream releases from Narmadasagar . . . . . 8.080 MAF

Evaporation loss pertaining to power . . . . . 0.737 MAF

Total water use for power . . . . . 8.817 MAF

3. Apportionment of cost between Irrigation and Power

(Rs. in crores)

Cost of Unit I (vide MP—1056). 95.38

The cost is to be apportioned between irrigation and power in the ratio of water use, i.e.

Irrigation 4.525 : Power 8.817

Cost chargeable to irrigation

$$\frac{95.38 \times 4.525}{4.525 + 8.817} = 32.35$$

Cost chargeable to power . . . . . = 63.03

TOTAL 95.38

4. Power generation at different projects

(a) Narmadasagar

Power draft . . . . . 8.08 MAF

Effective head 2/3(860—798)+798—648 . . . . . = 191 feet

Power generation at 100% LF = $\frac{191 \times 1381 \times 8.08}{14}$ . . . . . = 152 MW

STATEMENT 15.5—*Contd.*

(b) Omkareshwar

Power draft 8.08—(1.561+0.168)+0.602 . . . . . =6.953 MAF

Effective head 2/3(660—635)+635—534 . . . . . =118 feet

Power generation at 100% LF

$$\frac{118 \times 1381 \times 6.953}{14} \quad \ldots \quad =81 \text{ MW}$$

Power generation attributable to Narmadasagar

Flow in eight months of non-filling period is $\frac{8}{12} \times 6.953$ . . . . . =4.635 MAF

Flow in non-filling period from Omkareshwar, when no regulated releases are made from Narmadasagar 0.621 MAF

Therefore, flow attributable to Narmadasagar in non-filling period . . . . . 4.014 MAF

Power generation at 100% LF

Attributable to Narmadasagar is $\frac{4.014}{6.953} \times 81$ . . . . . =50 MW

(c) Maheshwar

Power draft . . . . . 6.953 MAF

Effective head 2/3(534—532)+532—457 . . . . . 76 feet

Power generation at 100% LF $\frac{76 \times 1381 \times 6.953}{14}$ . . . . . =52 MW

Power generation attributable to Narmadasagar $\frac{4.014 \times 52}{6.953}$ . . . . . =30 MW

(d) Sardar Sarovar

Cana ihead P.H.

Power draft . . . . . 9.5 MAF

Effective head 2/3(455—363)+363—307 . . . . . =117 feet

Power generation at 100% LF=$\frac{117 \times 1381 \times 9.5}{14}$ . . . . . =109 MW

If there are no regulated releases from Narmadasagar the loss of irrigation and power at Sardar Sarovar Canal would be 17.8 per cent.

Therefore, power generation attributable to Narmadasagar is $=\frac{17.8 \times 109}{109}$ . . . . . =19 MW

TOTAL a+b+c+d . . . . . =251 MW

5. Power cost chargeable to Sardar Sarovar

Amount chargeable $= \frac{19}{251} \times 63.03$ . . . . . =Rs. 4.77 crores

6. Irrigation cost chargeable to Sardar Sarovar

Irrigation use at Narmadasagar and Omkareshwar . . . . . 2.834 MAF

Irrigation use at Sardar Sarovar attributable to Narmadasagar . . . . . 1.691 MAF

Cost of Narmadasagar chargeable to irrigation is . . . . . Rs. 32.25 crores

Cost chargeable to Sardar Sarovar is= $\frac{32.25 \times 1.691}{2.834+1.691}$ . . . . . =Rs. 12.05 crores

7. Total cost chargeable to Sardar Sarovar

Power component . . . . . Rs. 4.77 crores

Irrigation component . . . . . Rs. 12.05 crores

Rs. 16.82 crores

This represents 17.63 per cent of the cost of Unit I of Narmadasagar.

CHAPTER XVI

DIRECTIONS TO MADHYA PRADESH, GUJARAT AND MAHARASHTRA AS REGARDS SUBMERGENCE, LAND ACQUISITION AND REHABILITATION OF DISPLACED PERSONS

16.1.1 Issues 19(i) and (ii) read as follows :—

19(i) Whether the proposed execution of the Navagam project with FRL 530 or thereabouts or less involving consequent submergence of a portion of the territories of Maharashtra and/or Madhya Pradesh can form the subject matter of a "water dispute" within the meaning of section 2(c) of the Inter-State Water Disputes Act (Act 33 of 1956).

19(ii) If the answer to 19(i) is in the affirmative, whether the Tribunal has jurisdiction :

(a) to give appropriate directions to Madhya Pradesh and/or Maharashtra to take steps by way of acquisition or otherwise for making the submerged land available to Gujarat in order to enable it to execute the Navagam project with FRL 530 or thereabouts or less ;

(b) to give consequent directions to Gujarat or other party State regarding payment of compensation to Maharashtra and/or Madhya Pradesh and/or share in the beneficial uses of Navagam Dam ; and

(c) for rehabilitation of displaced persons.

These issues were considered in our preliminary judgement dated 23rd February, 1972 and were answered in the affirmative. At page 120 of the judgment, the Tribunal came to the conclusion that it has jurisdiction :—

"(a) to give appropriate directions to Madhya Pradesh and Maharashtra to take steps by way of acquisition or otherwise for making submerged land available to Gujarat in order to enable it to execute the Navagam Project with FRL 530 or thereabouts or less ;

(b) to give consequent directions to Gujarat or other party States regarding payment of compensation to Maharashtra and Madhya Pradesh or/and giving them a share in the beneficial use of the Navagam Dam ; and

(c) for rehabilitation of displaced persons."

16.1.2 In connection with Issue 19(ii), it was argued by Madhya Pradesh that Narmada is a public navigable river and therefore the ownership of the bed belongs to the State Government and Gujarat is liable to pay compensation for any portion of the river bed if it is affected by submergence due to the proposed Navagam Dam. The argument was also stressed that fishing rights in the Narmada river also belong to Madhya Pradesh.

16.1.3 Under the English Common Law, the legal incidents of navigability do not attach to a river unless it is both tidal and navigable (Halsbury's Laws of England, III Edition, Volume 39, pages 509 and 510, para 664 and 667). But there has been a departure from the English Common Law Rule in the United States. It was held by the United States Supreme Court in U.S. V/s Utah[1] thtat rivers, either tidal or fresh water, are in law public navigable rivers if they are navigable in fact when they are used or are susceptible of being used in their ordinary condition as highways of commerce. (See the Steamer Daniel Ball and others V/s United States[2] ; and Arizona V/s California[3]). In American Jurisprudence, Second Edition, 1975. summarised :

Volume 78, the law as to what constitutes navigability in fact and the legal requisites of navigability have been summarised :

"It is not necessary that the waters be navigable in all their parts in order that the public may have a right of navigation, where there is sufficient depth and fitness for such use. The navigability of a stream may be of a substantial part thereof only. Navigability in the sense of the law is not destroyed because the water course is interrupted by occasional natural obstructions or portages. If freedom from all natural obstructions were a test of navigability it would exclude many of the great rivers of the country, which are so interrupted by rapids so as to require artificial means to enable them to be navigated without break." (ibid PP. 507-508).

16.1.4 While discussing the aspect of "Times of Navigability : intermittent or periodic navigability", it is pointed out :—

"In order that a stream or body of water may be navigable in the legal sense, it is not necessary it be capable of navigation at all seasons of the year, or at all stages of the water. If in its natural state and with its ordinary volume of water, either constantly or at regularly recurring seasons, it has such capacity that it is valuable to the public it is sufficient. As stated in some cases, a stream, to be navigable, must be capable of naviga-

[1] 283 US 64 (75 Law Ed. 844)
[2] 77 U.S. 559
[3] 283 U.S. 423, 452.

4 A&I/78—14

tion either for the whole or part of the year. The fact that in the dry season a stream is not capable of use, or that in times of drought navigation is difficult, and sand-bars and vegetation at times interfere with navigation, does not necessarily detract from the character of a stream as a navigable one. But the period of capacity must be sufficiently regular and continued to make the stream of commercial importance or of significant value to the public." (ibid pages 508 & 509).

16.1.5 In Raja Srinath Roy and others V/s Dinabandhu and Others(4) the Judicial Committee adopted the principle laid down in the American decision as applicable to India. Lord Sumner speaking for the Board observed :

"The question how far a rule established in this country can be usefully applied in another, whose circumstances, historical, geographical, and special, are widely different, is well illustrated by the case of navigability, as understood in the law of the different states of the United States of America. Navigability affects both rights in the waters of a river, whether of passing or repassing or of fishing, and the rights of riparian owners, whether as entitled to make structures on their soil which affect the river's flow, or as suffering in respect of their soil quasi-servitudes of towing, anchoring or landing in favour of the common people. The courts of the different States, minded alike to follow the common law where they could, found themselves in the latter part of the eighteenth and the early part of the nineteenth centuries constrained by physical and geographical conditions to treat differently. In Massachusetts, Connecticut, New Hampshire and Vermont, where the rivers approximated in size and type to the rivers of this country, the English common law rule was followed that tidality decided the point at which the ownership of the bed and the right to fish should be public on the one side and private on the other. Other States, though possibly for other reasons since they possessed rivers very different in character from those of England, namely, Virginia, Ohio, Illinois and Indiana followed the same rule. But in Pennsylvania, North Carolina, Iowa, Missouri, Tennessee and Alabama, this rule was disregarded, and the test adopted was that of navigability in fact, the Courts thus approximating to the practice of Western Europe (See Kent's Commentaries, iii, 525). The reasoning has been put pointedly in Pennsylvania. Chief Justice Tilghman says in 1810, in Carson v. Blazer (33)

"the common law principle concerning rivers" (viz., that rivers, where the tide does not ebb and flow, belong to the owners of adjoining lands on either side), "even if extended to America, would not apply to such a river as the Susquehanna, which is a mile wide and runs several hundred miles through a rich country, and which is navigable and is actually navigated by large boats. If such a river had existed in England no such law would ever have been applied to it."

[See too, Shrunk v. Schuylkill Navigation Co. (34)]. Thirty years later in Zimmerman v. Union Canal Co. (35) President Porter observes :

"the rules of the common law of England in regard to the rivers and the rights in riparian owners do not extend to this Commonwealth, for the plain reason that rules applicable to such streams as they have in England above the flow of the tide, scarcely one of which approximate to the size of the Swatara, would be inapplicable to such streams as the Susquehanna, the Allegheny, the Monogahela," and sundry other "rivers of Damascus".

A similar deviation, equally ground in good sense, from the strict pattern of the English law of waters lies at the bottom of the current of Indian cases previously referred to and forms its justification."

16.1.6 The principle was reiterated by Lord Normand in Maharaja of Pittapuram v. Province of Madras.(5) At page 5, Lord Normand states :

"In the High Court the argument proceeded, as the judgment records, on the footing that the Godavari is a public navigable river, but counsel for the appellant submitted to their Lordships that because the river was not navigable at all seasons in all parts of the eastern side at the locus it must be treated as non-navigable on the eastern side. Their Lordships have no hesitation in rejecting this novel contention or in holding that an embanked river which includes a navigable channel is to be treated as without qualification a navigable river between its embankments."

16.1.7 In its Statement of Case Gujarat has averred that "Narmada river was navigable in its tidal reach upto Broach 48 KM from the mouth by vessels of 70/80 tonnes, and in the further reach of the 48 KM i.e. upto Chandod, by "small" country crafts" (Gujarat Statement of Case Volume I, page 7.) In the report of the Inland Water Transport Committee it has been pointed that the Narmada is navigable by sailing vessels and country boats for total distance of 100 KM and 60 KM from Tilakwada to the sea almost during the whole year (G/208, page 102, para. 14).

Applying the principle of the decision of the Judicial Committee in the Pittapuram case to the admitted facts

4 AIR 1914 Privy Council 48
5 AIR 1949 Privy Council 3

of the present case, we are satisfied that the Narmada River should be held to be a public navigable river as a matter of law.

16.1.8 As regards the ownership of the bed of a public navigable river also, the decision of the Judicial Committee in the Pittapuram case makes it clear that the tidality of a river so far as the rivers in India are concerned, is an immaterial consideration. It was contended in that case on behalf of the appellant that in Common Law where a river was non-tidal, though *navigable*, its bed belonged to the riparian proprietor. The argument was rejected by the Judicial Committee and it was held that the bed of a navigable river in any part of India, whether tidal or not, is vested in the Government unless it has been granted to private individuals.

16.1.9 The further question arises as to whether the bed of a public navigable river in India belongs to the State Government or to the Union Government. The contention of Madhya Pradesh is that the ownership of the river bed vests in the State Government and not in the Union Government. Section 172(1) of the Government of India Act, 1935, provided that all properties vesting in His Majesty for the purposes of the Government of India before the commencement of Part III of that Act vested in His Majesty. The scheme of section 172 of the Government of India Act, 1935, was that all properties situated in a province or elsewhere vested in His Majesty and where lands and buildings were situated in a Province they were vested in His Majesty for the purposes of the Government of that Province. Subject to certain exceptions, which are not material in the present case, lands and buildings which were situated in a province but in view of the exceptions did not vest for the purposes of the Government of that Province, vested in His Majesty and lands and buildings situated elsewhere than in a Province, vested in His Majesty for the purpose of the Government of the Federation. The legal position has been changed as a result of Article 294 of the Constitution which states :—

> "As from the commencement of this Constitution
>
> (a) all property and assets which immediately before such commencement were vested in His Majesty for the purposes of the Government of the Dominion of India and all property and assets which immediately before such commencement were vested in His Majesty for the purposes of the Government of each Governor's Province shall vest respectively in the Union and the corresponding State....."

16.1.10 In Re. The Allocation of Lands and Buildings in a Chief Commissioner's Province[6] the Federal Court relied upon the capacity to legislate as disclosed by the entries in the legislative lists as indicative of the purpose for which the particular item of property was to be held by the Crown. At page 30 of the Report, Sir Maurice Gwyer, C.J. Stated :—

> "That part of the canal which was, immediately before the commencement of the Act, still used for irrigation purposes in the Province of Delhi must, we think, be held to have been used at that date for purposes which thereafter became Central Government purposes, since irrigation and canals are a Provincial subject, and the Central Government has all the powers of a Province in the centrally administred areas [ss. 8(i)(a) and 100(4)]. It seems an irrelevant consideration that the Central Government may have found it convenient to request or permit the Punjab Government to continue to administer so much of the canal as, after the separation of the Province of Delhi, was situate in that province; and it seems equally irrelevant that the canal forms part of the Punjab irrigation system and that the water in it comes from the Punjab."

16.1.11 In view of the entries 19 and 21 of List II of the Government of India Act, 1935 and corresponding entries 17 and 18 of List II of the Seventh Schedule of the Constitution, we hold in the present case that the bed of the Narmada river belongs to the State in whose territory the river passes and the Union of India has no right of ownership of the river bed. A similar view has been expressed by the Supreme Court in Bhagwan Das V/s State of Uttar Pradesh[7].

16.1.12 Gujarat and Maharashtra do not contest the legal position in the last paragraph. We had also issued notice to the Union of India in connection with this matter. The Union of India appeared before the Tribunal and filed CMP 10 of 1978 enclosed as Annexure XVI-1 stating that "for the purpose of the present proceedings the Union of India has decided not to contest the issue whether the River Narmada is a public navigable river and if so in whom the bed of the river vests as a matter of law."

16.2.1 It was also contended on behalf of Madhya Pradesh that the fishing rights in the Narmada river must be held to belong to Madhya Pradesh Government while the river flows through its territory. In our opinion, this argument must be accepted as correct. In Anand Behara and another Vs. State of Orissa and another[8] it was held by the Supreme Court that the right to catch and carry fish was tantamount to a licence to enter upon the land coupled with a grant to catch and carry fish. In English law such a right is held to be a *profit a prendre* [11 Halsbury's Laws of England (Hailsham Edition), pages 382 and 383]. In English law, this is regarded as an interest in land because it is a right to take some profit of the soil for the use of the owner of the right. (11 Halsbury's Law of England, Hailsham Edition, page 382). In India such a right is regarded as a benefit which arises out of land and as such is "immoveable property" within the meaning of the Transfer of Property Act. This legal position is not controverted by Gujarat or Maharashtra.

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[6] 1943 Federal Cour Reports 20

[7] AIR 1976 Supreme Court 1393.

[8] (1955) 2 SCR 919

16.3.1 Madhya Pradesh has suggested draft directions as regards submergence, land acquisition and rehabilitation in Madhya Pradesh Statements 120, 136 and 141. The draft directions suggested by Gujarat are contained in Gujarat Statements 41 and 53. The suggestions of Maharashtra are contained in Maharashtra Notes 46, 47, 47-A and Maharashtra Statement No. 16.

16.4.1 After hearing the various view points put forth by the party States, we make the following directions :

Clause I : *Definitions* :

1(1) "Land" The expression "land" shall have the same meaning as defined in the Land Acquisition Act, 1894, (hereinafter referred to as the Act) which states "the expression 'land' includes benefits to arise out of land. and things attached to the earth or permanently fastened to anything attached to the earth."

1(2) *"Oustee" An "Oustee"* shall mean any person who since at least one year prior to the date of publication of the notification under section 4 of the Act, has been ordinarily residing or cultivating land or carrying on any, trade, occupation or calling or working for gain in the area likely to be submerged permanently or temporarily.

I(3) *"Family"* (i) A family shall include husband, wife and minor children and other persons dependent on the head of the family, e.g. widowed mother.

(ii) Every major son will be treated as a separate family.

II. *Lands which are to be compulsorily acquired* :

II(1) : Madhya Pradesh and Maharashtra shall acquire for Sardar Sarovar Project under the provisions of the Land Acquisition Act, 1894, all lands of private ownership situated below FRL 455 of Sardar Sarovar and all interests therein not belonging to the respective States. If on the basis aforesaid, 75 per cent or more land of a contiguous holding of any person is required to be compulsorily acquired, such person shall have the option to compel compulsory acquisition of the entire contiguous holding.

II(2) : Madhya Pradesh and Maharashtra shall also acquire for Sardar Sarovar Project under the provisions of the Land Acquisition Act, 1894, all buildings with their appurtenant lands situate between FRL +455 and MWL +460 including backwater effect.

II(3) : The backwater level at the highest flood level in Sardar Sarovar shall be worked out by the Central Water Commission in consultation with Madhya Pradesh and Gujarat.

III. *Liability of Gujarat to Pay Compensation for Land Acquisition and Rehabilitation etc.*

III(1) : Gujarat shall pay to Madhya Pradesh and Maharashtra all costs including compensation, charges and expenses incurred by them for or in respect of the compulsory acquisition of lands required to be acquired as aforesaid.

III(2) : Gujarat shall pay to Madhya Pradesh and Maharashtra and the Union of India compensation for the respective Government lands and structures on principles similar to those underlying the Land Acquisition Act, 1894. Where any dispute or difference arises between Gujarat, Madhya Pradesh, Maharashtra, and the Union of India with respect to the compensation payable as aforesaid, any of the three States of Gujarat, Madhya Pradesh and Maharashtra or the Union of India may refer the matter in dispute to arbitration. The State of Gujarat on the one hand and the States of Madhya Pradesh, Maharashtra or the Union of India (as the case may be) on the other hand shall respectively nominate one Arbitrator each. In the event of disagreement between the Arbitrators, such dispute or difference shall be referred to an Umpire who shall be a person appointed in that behalf by the Chief Justice of India from among persons who are, or have been Judges of the Supreme Court. The decision of the Arbitrators or, as the case may be, of the Umpire shall be final and binding on the parties and shall be given effect to by them. Madhya Pradesh, Maharashtra or the Union of India (as the case may be) on the other hand shall respectively nominate one Arbitrator each. The decision of the Umpire and arbitrators shall be final and binding on the parties and shall be given effect to by them.

III(3) : Gujarat shall pay to Madhya Pradesh and Maharashtra land revenue in accordance with the respective Land Revenue Codes of Madhya Pradesh and Maharashtra in respect of all lands in their respective territories acquired for Gujarat or conveyed to it.

III(4) : Gujarat shall pay to Madhya Pradesh and Maharashtra all costs, charges and expenses incurred by Madhya Pradesh and Maharashtra for the purpose of removal and reinstallation of any ancient or historical monuments, archaeological remains, religious place of workship or idols likely to be affected by submergence under Sardar Sarovar and that in the event of such payment being made, no separate compensation as hereinbefore provided shall be required to be paid in respect of the same having been affected by the sumbergence.

III(5) : Gujarat shall pay to Madhya Pradesh and Maharashtra all costs, charges and ex-

penses required to be incurred by them for rehabilitation of oustees and oustee families in their respective territories in accordance with the directions hereinafter contained.

III(6) : Gujarat shall pay to Madhya Pradesh and Maharashtra costs on account of establishment charges for land acquisition and rehabilitation and other departmental staff which Madhya Pradesh and Maharashtra may consider necessary for the purpose of such acquisition and rehabilitation.

IV. *Provision for Rehabilitation* :

IV(1) : According to the present estimates the number of oustee families would be 7,366 spread over 173 villages in Madhya Pradesh, 467 families spread over 27 villages in Maharashtra. Gujarat shall establish rehabilitation villages in Gujarat in the irrigation command of the Sardar Sarovar Project on the norms hereinafter mentioned for rehabilitation of the families who are willing to migrate to Gujarat. For oustee families who are unwilling to migrate to Gujarat, Gujarat shall pay to Madhya Pradesh and Maharashtra the cost, charges and expenses for establishment of such villages in their respective territories on the norms as hereinafter provided.

IV(2)(i) : According to the present estimates the number of oustee families below RL 350 would be 30 spread over 20 villages in Madhya Pradesh and 250 families spread over 20 villages in Maharashtra. Within six months of the publication of the decision of the Tribunal in the Official Gazette, Gujarat, Madhya Pradesh and Maharashtra shall determine by mutual consultation the location of one or two rehabilitation villages in Gujarat to rehabilitate oustees from areas below RL +350. Gujarat shall acquire necessary lands for the rehabilitation villages and make available the same within two years of the decision of the Tribunal. Within six months of the decision of the location of the rehabilitation villages in Gujarat, Madhya Pradesh and Maharashtra shall intimate to Gujarat the number of oustee families from areas below RL 350 willing to migrate to Gujarat. For the remaining oustee families, Madhya Pradesh and Maharashtra shall arrange to acquire lands for rehabilitation within the respective States.

IV(2)(ii) : Madhya Pradesh and Maharashtra shall set up adequate establishments for land acquisition and rehabilitation of oustee families. Gujarat shall deposit within 3 months of the decision of the Tribunal Rupees ten lakhs each with Madhya Pradesh and Maharashtra in advance towards cost of establishment and rehabilitation in these States to be adjusted after actual costs are determined. Madhya Pradesh and Maharashtra shall start land acquisition proceedings for areas below RL +350, within six months of the decision of the Tribunal and convey the lands to Gujarat for project purposes within 3 years of the decision of the Tribunal. Within 18 months of the decision of the Tribunal, Gujarat shall make an advance payment of Rs. 70 lakhs to Madhya Pradesh and Rs. 100 lakhs to Maharashtra towards the compensation of land, to be adjusted after actual costs are determined.

IV(2)(iii) : Regarding the oustee families from areas above RL +350, Gujarat shall intimate to Madhya Pradesh and Maharashtra within 6 months of publication of the decision of the Tribunal in the Official Gazette the number and general location of rehabilitation villages proposed to be established by Gujarat in accordance with the decision of the Tribunal. Within one year of the receipt of proposal of Gujarat, both Madhya Pradesh and Maharashtra shall intimate to Gujarat the number of oustee families willing to migrate to Gujarat. The three States by mutual consultation shall determine within two years of the decision of the Tribunal, the number and general location of rehabilitation villages required to be established by Gujarat in its own territory. Madhya Pradesh and Maharashtra shall intimate to Gujarat the number of such villages to be established in Madhya Pradesh and Maharashtra and for which Gujarat would be required to make payments to Madhya Pradesh and Maharashtra respectively.

IV(2)(iv) : Gujarat shall acquire and make available a year in advance of the submergence before each successive stage, irrigable lands and house sites for rehabilitation of the oustee families from Madhya Pradesh and Maharashtra who are willing to migrate to Gujarat. Gujarat shall in the first instance offer to rehabilitate the oustees in its own territory.

IV(3) : Gujarat shall also provide the following grants and amenities to the oustees :—

(a) Resettlement Grant (Rehabilitation Grant) —Gujarat shall pay per family a sum of Rs. 750 inclusive of transportation charges as resettlement grant.

(b) Grant-in-aid.

In addition, Gujarat shall pay per family grant-in-aid in the following scale :—

Where total compensation is received	*Grant-in-aid*
Above Rs. 2000/-	Nil
Between Rs. 2000/- and Rs. 500/-	Rs. 500/- less an amount equal to one third of the compensation in excess of Rs. 500/-.
Less than Rs. 500/-	Rs. 500/-.

(c) *Civic amenities* :

1. One primary school (3 rooms) for 100 families.
2. One Panchayat Ghar for every 500 families.
3. One Dispensary for every 500 families.
4. One seed store for every 500 families.
5. One children's park for every 500 families.
6. One village pond for every 500 families.
7. Drinking water well with trough for every 50 families.
8. Each colony should be linked to main road by roads of appropriate standard.
9. One platform for every 50 families.
10. Every oustee family shall be entitled to and allotted a house site, i.e. a plot of land measuring 60′×90′ free of cost. In addition, a provision of 30 per cent additional area for roads, Government buildings, open space etc. shall be made by Gujarat under civic amenities.
11. The State of Gujarat shall make the following provisions for rehabilitation in Madhya Pradesh and Maharashtra :—

	Rs.
(a) Resettlement	750/- per family
(b) Grant-in-aid	500/- per family
(c) Acquisition of land for resettlement of families affected @ one acre for 6 families	1500/- per acre
(d) Civic amenities :	
1. One primary school @ 100 families	30000/- each
2. One Community Hall-cum-Panchayat Bhawan @ 500 families	20000/- each
3. One Dispensary @ 500 families	25000/- each
4. One seed store @ 500 families	10000/- each
5. One Children's Park @ 500 families	6000/- each
6. One well with trough @ 50 families	10000/- each
7. One pond @ 500 families	20000/- each
8. One tree platform @ 50 families	1500/- each
9. One religious place of worship @ 100 families	1000/- each
10. Construction of approach roads & link roads for Abadies 3 KM per every new Abadi	30000/- per KM
11. Electrical distribution lines & Street lights 2 KM per 100 families	11000/- per KM
12. Social amenities for each municipal town going under submergence viz., water supply & sanitary arrangements, lay-out levelling of site etc.	500000/- each town

IV(4)(i) : Gujarat is directed to provide for rehabilitation and civic amenities as per directions contained hereinabove in Clause IV(3) in its estimate for B-Land compensation and rehabilitation.

IV(4)(ii) : Notwithstanding the provisions hereinabove contained, Gujarat shall not be liable to pay any compensation for the loss of public properties, facilities or amenities such as drinking water wells, primary school buildings, internal roads, village sites, approach roads, dispensaries, Panchayat Buildings, rural electrification, highway, bridges, telegraph lines, power lines, etc. if corresponding alternative properties, facilities or amenities are to be provided at the cost of the Sardar Sarovar Project. The party owning the facility shall have the option to accept compensation for utilities as existing or ask for their replacement or re-location at the cost of Gujarat.

IV(5) : It is made clear that the monetary values in Clause IV(3)(c) are liable to be changed at the time of actual rehabilitation. Where any dispute or difference arises as regards the changed valuation, the matter shall be determined by arbitration in the manner provided in Clause III(2) above and Gujarat's liability shall stand altered accordingly.

IV(6)(i) : In the event of Gujarat being unable to resettle the oustees or the oustees being unwilling to occupy the area offered by Gujarat, Madhya Pradesh and Maharashtra shall make such provisions for rehabilitation, civic amenities etc. on the lines mentioned in Clause IV(1) to (4) above. Gujarat shall, in that event, be liable to pay all such expenses, costs etc. arising out of or in connection with rehabilitation and provision of civic amenities for the oustees including the cost of all acquisition proceedings and payment of compensation etc. as per the Land Acquisition Act, for the land allotted to oustees for cultivation and habitation.

IV(6)(ii) : In no event shall any areas in Madhya Pradesh and Maharashtra be submerged under the Sardar Sarovar unless all payment of compensation, expenses and cost as aforesaid is made for acquisition of land and properties and arrangements are made for the rehabilitation of the oustees therefrom in accordance with these directions and intimated to the oustees.

IV(7) : *Allotment of Agricultural Land* : Every displaced family from whom more than 25 per cent of its land holding is acquired shall be entitled to and be allotted irrigable land to the extent of land acquired from it subject to the prescribed ceiling in the State concerned and a minimum of 5 acres per family. This land shall be transferred to the oustee family if it agrees to take it. The price charged for it would be as mutually agreed between Gujarat and the concerned

State. Of the price to be paid for the land a sum equal to 50 per cent of the compensation payable to the oustee family for the land acquired from it will be set off as an initial instalment of payment. The balance cost of the allotted land shall be recovered from the allottee in 20 yearly instalments free of interest. Where land is allotted in Madhya Pradesh or Maharashtra, Gujarat having paid for it vide clause IV(6)(i) supra, all recoveries for the allotted land shall be credited to Gujarat.

IV(8) : Any dispute between the States in respect of Clauses IV(1) to (7) of these directions shall be referred to and determined by arbitration in the manner provided in Clause III(2) of these directions.

V. *Programme for Payment to be made by Gujarat to Madhya Pradesh and Maharashtra.*

V(1) : As soon as practicable after the publication of the decision of the Tribunal in the Official Gazette, Gujarat shall prepare and furnish to the other party States, a fresh estimate of sub-head B-Land for the Sardar Sarovar Project as permitted by the Tribunal including in particular, costs of acquisition of lands in Madhya Pradesh and Maharashtra and of rehabilitation of oustee families in Madhya Pradesh and Maharashtra.

V(2)(i) As soon as practicable after the publication of the decision of the Tribunal in the Official Gazette and in any case before expiry of three months thereafter, both Madhya Pradesh and Maharashtra shall furnish to Gujarat three sets of Majmuli/Taluka maps of all talukas in their respective territories likely to be submerged wholly or partly under Sardar Sarovar. These maps shall indicate village boundaries. Within three months after the receipt of the Majmuli/taluka maps Gujarat shall mark thereon the boundary of the area situated below the FRL as also that between FRL and MWL, including backwater effect and shall return one respective set so marked to Madhya Pradesh and Maharashtra.

V(2)(ii) : As soon as practicable after the receipt of one set of the Majmuli/Taluka maps marked as aforesaid and in any case within six months thereof, the Government of Madhya Pradesh and Maharashtra shall, publish notifications under sub-section (1) of section 4 of the Act notifying that the lands in their respective territories situated below the FRL and the buildings with their appurtenant land between FRL and MWL including backwater effect (to be specified in the notifications) are likely to be needed for the Sardar Sarovar Project.

V(2)(iii) : As soon as practicable after publication of the decision of the Tribunal in the Official Gazette as hereinbefore referred to and in any case within one year thereof, Gujarat shall intimate to Madhya Pradesh and Maharashtra yearwise programme of construction of the dam.

V(2)(iv) : Objections, if any, received against the proposed acquisition of lands as notified under section 4 of the Act shall be heard and disposed of and any reports to the State Governments as contemplated by Sub-section (2) of Section 5A of the Act shall be made with utmost expedition. The Governments of Madhya Pradesh and Maharashtra shall issue requisite notifications under section 6 of the Act with utmost expedition and in any case before the expiry of three years from the dates of publication of the respective notifications under sub-section (1) of Section 4 of the Act.

V(2)(v) : As soon as practicable, after receipt of the yearwise programme of construction of the Sardar Sarovar dam from Gujarat both Madhya Pradesh and Maharashtra in consultation with Gujarat shall finalise their respective yearwise programme of completing the proceedings for compulsory acquisition of lands in their respective territories upto the stages of making awards under section 11 of the Act and of taking possession of the lands under section 16 of the Act.

V(3)(i) : Gujarat is required to pay to Madhya Pradesh and Maharashtra compensation for compulsory acquisition of lands, market value of Governments lands to be conveyed to Gujarat and expenditure to be incurred in connection with the rehabilitation of oustees families to be rehabilitated in Madhya Pradesh and Maharashtra as hereinbefore provided. Madhya Pradesh and Maharashtra shall on or before 30th September of each year intimate to Gujarat the amounts required to be paid by Gujarat to Madhya Pradesh and Maharashtra respectively having regard to (a) the extent of lands in Madhya Pradesh and Maharashtra in respect of which awards are likely to be made under section 11 of the Act (b) the extent of Government lands likely to be conveyed by Madhya Pradesh and Maharashtra to Gujarat during the next financial year and (c) the expenditure likely to be incurred by Madhya Pradesh and Maharashtra in connection with rehabilitation of oustee families in Madhya Pradesh and Maharashtra during the next financial year. In arriving at these estimates for the next financial year, Madhya Pradesh and Maharashtra shall also take into account the differences, if any between the payments made by Gujarat in pursuance of this Clause for the current financial year and the amount actually payable during the said financial year.

V(3)(ii) : On the basis of these estimates, Gujarat shall on or before the 31st May of

the following financial year make payments to Madhya Pradesh and Maharashtra of the amounts estimated as provided in Clause V(3)(i) above.

V(3)(iii) : Gujarat shall at each successive stage of submergence intimate to Madhya Pradesh and Maharashtra the area coming under submergence at least 18 months in advance. The inhabitants of the area coming under the respective stages of submergence will be entitled to occupy or use their properties without being required to pay anything for such occupation and use till a date to be notified by the State concerned which date shall not be less than six months before submergence. They must vacate the area by the notified date.

V(4)(i) : On payment of the amounts to be paid each year by Gujarat as compensation for compulsory acquisition of lands as aforesaid. Madhya Pradesh and Maharashtra shall as expeditiously as possible complete the acquisition and transfer such lands to Gujarat so as to vest the lands in Gujarat to be used only for the purpose of submergence and subject to clauses V(5) to (8) of these directions.

V(4)(ii) : On payment of the market value of Government lands by Gujarat as hereinbefore provided Madhya Pradesh and Maharashtra and the Union of India shall convey such lands to Gujarat so as to vest in Gujarat to be used only for the purpose of submergence and subject to clauses V(5) to (8) of these directions.

V(5) : Gujarat shall pay to Madhya Pradesh and Maharashtra the amount of land revenue payable every year for the lands coming under submergence, at the rates prevailing in Madhya Pradesh from time to time.

V(6) : Notwithstanding vesting in Gujarat of the lands coming under submergence, Madhya Pradesh and Maharashtra shall continue to enjoy all rights of sovereignty intact over the submerged area in the respective States.

V(7) : Madhya Pradesh and Maharashtra respectively shall be exclusively entitled to all rights of fishing, boating and water transportation over the part of lake over the submerged land within Madhya Pradesh and Maharashtra respectively provided, however, that such right is not exercised to the prejudice of any utilities of the Sardar Sarovar Project or cause hindrance in the legitimate performance of their duties by the project personnel.

V(8) : All residual rights not specifically transferred to Gujarat in respect of the lands coming under submergence shall continue to vest in the Government in whose territory they are situated.

V(9) In the event of the said lands not being used for the purposes of submergence for which it is acquired, the State of Gujarat shall retransfer such land to Madhya Pradesh or Maharashtra as the case may be subject to the condition that Madhya Pradesh and Maharashtra refund to Gujarat the amount of compensation received from Gujarat in respect of such land.

V(10) In the event of any land acquired for rehabilitation of oustee families is not used for the purpose, it shall be returned to the original owner on payment, where feasible, or otherwise disposed of and due credit given to Gujarat.

V(11) All costs incurred by Gujarat on acquisition of land and rehabilitation of oustees in respect of Sardar Sarovar shall be charged to Sardar Sarovar Project estimate, Unit I—Dam and Appurtenant Works.

VI : Nothing contained in this Chapter shall prevent the alteration, amendment and modification of all or any of the foregoing clauses by agreement between all the party States.

16.5.1 We have consulted our Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this Chapter. They all advise us that they agree with the directions contained in paragraph 16.4.1.

ANNEXURE XVI-1
CMP No. 10/78-NWDT.

Before the Narmada Water Disputes Tribunal

In the matter of : Water Disputes regarding the Inter-State River Narmada and the River Valley thereof.

AND

In the matter of :

The State of Gujarat ..... Complainant

AGAINST

The State of Madhya Pradesh and others ..... Respondents

Subject : *STATEMENT BY THE UNION OF INDIA*

May it please this Honourable Tribunal,

1. By its order dated the 30th November, 1977, this Honourable Tribunal had granted time to the Union of India till 7th January, 1978 to file a CMP on the following item :—

'Whether the River Narmada is a public navigable river in the legal sense and in whom does the bed of river Narmada vest as a matter of law i.e. whether in the Union of India or in the States concerned, namely Madhya Pradesh, Gujarat or Maharashtra, as the case may be.'

2. It is submitted that the Union of India has taken considerable time to examine the issue mentioned above and, after careful consideration, the Union of India has decided, for the purpose of the present proceedings not to contest the issue whether the river Narmada is a public navigable river and, if so in whom the bed of the said river vests.

Settled by : Smt Shyamla Pappu
Sr. Counsel for the
Govt. of India.

Thro : V.P. Nanda,
Counsel for
Govt. of India.

dt. 7-1-78

4 A&I/78—15

CHAPTER XVII

ALLOCATION OF COST SARDAR SAROVAR PROJECT

17.1.1 Issue No. 17 states—

> "Whether the costs and benefits of the Navagam Project of Gujarat are required to be shared amongst the concerned States? If so, in what manner and on what terms and conditions?"** **.

17.1.2 The Sardar Sarovar Project is multipurpose in scope and envisages both irrigation and power generation. Also the project would bestow benefits upon more than one State. It is, therefore, necessary to apportion its cost between irrigation and power and to determine the cost share of the beneficiary States.

17.1.3 The Sardar Sarovar Project does not cater for any flood control and the moderation in flood flows on the reservoir level rising above FRL would be unregulated. The benefit of flood moderation would thus be incidental and no cost will have been incurred to secure it. No part of the cost of the project may, therefore, be charged to flood control.

Cost to be Apportioned

17.1.4 The cost estimate of Sardar Sarovar Project prepared by Gujarat in Exhibit G-1087 (Februarv 1977) is divided in three parts as under :—

Unit I	—	Dam and appurtenant works
Unit II	-	Canals
Unit III	—	Power

This is on prescribed lines and the actual cost would, therefore, be computed accordingly. Obviously, the entire cost under Unit II—Canals, is chargeable to irrigation and that under Unit III—Power, to power. It is only the cost of Unit I—Dam and appurtenant works, which has to be apportioned between irrigation and power as this unit serves both the purposes. This cost will include credit which Sardar Sarovar would give to Narmadasagar for regulated releases.

Method of Apportionment

17.1.5 The Government of India, in its letter No. 1(6)/62-Policy dated 17th April, 1967 (Annexure XVII-1) to all State Governments desired that a uniform method of cost allocation to main functions should be made applicable to all multipurpose river valley projects and advised that the "facilities used" method should be adopted for the purpose. The two most common ways of assessing the facilities used are:

(i) reservoir capacity used for each purpose; and

(ii) the quantity of water utilised for each purpose.

The reservoir capacity method, however, does not lend itself to precise evaluation in the present case. The quantity of water utilised method should, therefore, be adopted. The same was done by Khosla Committee (1965).

17.1.6 The inflows received at Sardar Sarovar can be considered in two parts viz. (a) the portion which would be let into Navagam Canal for use by Gujarat and Rajasthan and (b) the portion which would flow down from the reservoir into the river. In the initial years of development of irrigation, the quantum of water which would flow down into the river would be relatively large and it would be possible to generate large blocks of power with it at the river bed power house. During this period power generation at the canal power house would be correspondingly small. Madhya Pradesh has stated that after ten years from the commencement of construction of Narmadasagar the utilisation of Narmada water in the State would be 6.00 MAF *vide* Madhya Pradesh CMP 116/77. In its Master Plan for Development of Water Resources of the Narmada (1972), Exhibit MP-312, Madhya Pradesh has indicated at page 54 of Volume IA that it would complete construction of its irrigation works in the basin in a period of 35 years. It is also likely that actual development of irrigation would require another period of 10 years. Madhya Pradesh would thus utilise its share of water of the Narmada only in a period of 45 years from the date of construction of the Narmadasagar Project. This assumption is supported by the Report of the National Commission of Agriculture (1976). In para 157 of Part V of its Report, the Commission has visualised the development of irrigation only by the year 2025. In Table 15.7 given in that paragraph, it is said that Madhya Pradesh has one of the largest balance of irrigation to develop next only to Uttar Pradesh and Bihar. The year 2025 would be 45 years from 1980 when we may reasonably expect the construction of Narmadasagar to be taken up. Gujarat has envisaged full development of Irrigation in a period of 30 years from the date of taking up of construction of Sardar Sarovar dam *vide* Exhibit G-177, Volume IV, pp. 449-450. Water use for the two purposes can thus be considered in three stages, namely, after 10 years, 30 years and 45 years of the date of commencement of construction.

17.1.7 The water fed into Navagam Canal would serve both the purposes of irrigation and power

generation. The water let down into the river would be used for power generation only. Taking into account the water used for the two purposes in different stages of development, the ratio of the water used for the two purposes in the conventional period of 100 years on completion of the dam has been worked out in Annexure XVII-2 and comes to :—

Irrigation	...	43.9 per cent
Power	...	56.1 per cent

The cost of Unit—Dam and appurtenant Works should, therefore, be apportioned between the two purposes in the above ratio.

Sharing of Cost by Gujarat and Rajasthan

17.2.1 Rajasthan's interest in Sardar Sarovar Project is confined only to irrigation. In a year of 75 per cent dependability Gujarat and Rajasthan would draw from Sardar Sarovar 9.0 and 0.5 MAF respectively. Any excess or shortage will also be shared in the same ratio. Therefore, the irrigation component of the cost of Sardar Sarovar Unit I—Dam and appurtenant Works should be shared by Gujarat and Rajasthan in the ratio of 9.0 to 0.5 or 18 to 1.

17.2.2 Rajasthan will be using the Navagam Main Canal for conveying its share of water from Sardar Sarovar. Ignoring the relatively small loss from the lined canals, the full share of Rajasthan will be conveyed over the entire length of Navagam Main Canal. On the other hand, the discharge which the Main Canal will carry for Gujarat will progressively get reduced at the off-take point of every branch or distributary. Normally the cost of Navagam Main Canal, including that of all structures on it excepting regulators at off-taking channels, should be shared by Gujarat and Rajasthan on cusec-mile basis. The discharge to be considered for the purpose at any point would be the maximum which the canal will have to carry there in any month for the State.

17.2.3 Gujarat has proposed that the Navagam Main Canal would take off at RL+300 and have a gradient of 1 in 10,000 upto the off-take of Banni branch at Mile 262 and 1 in 6000 for its remaining length from mile 262 to mile 310 upto Gujarat-Rajasthan border, *vide* Exhibit G-177, Vol. III, p. 367. According to this proposal, the FSL of the canal at Rajasthan border would be +99.47. In CMP No. 298 of 1977, Gujarat has stated that "If Gujarat is required to construct Navagam Main Canal off-taking from Sardar Sarovar with a slope flatter than that envisaged in its scheme, it would be done for the sole purpose of conveying the water for Rajasthan to predetermined elevation level at Gujarat-Rajasthan border. The entire additional cost on account of adopting flatter canal is required to be borne by Rajasthan."

17.2.4 In the Chapter on FSL of Navagam Canal, it has been prescribed that the canal should have a gradient of 1 in 12,000 upto the off-take of Saurashtra Branch at about Mile 180 and 1 in 10,000 thereafter upto Gujarat-Rajasthan border. Gujarat has proposed a steeper gradient in order to have a more economical section of the channel and save on cost of lining. The flatter gradient now prescribed would bring some more area in Gujarat under flow irrigation. But in the absence of corresponding increase in the apportionment of water for Gujarat, it gives Gujarat only the advantage of a wider choice of area for actual irrigation from the flow command thus enlarged. Rajasthan, on the other hand, gets considerable advantage of bringing substantial area of good irrigability under flow command which but for the flatter gradient now prescribed would have to be irrigated by lift. It would, therefore, be reasonable that Rajasthan should pay for this benefit. By and large, the overall difference in cost of masonry structures on the canal would be relatively small for gradients proposed by Gujarat and that now prescribed. Also, it would require an inordinate effort to determine this difference as for doing so designs will need to be prepared for all the structures for the two cases. This cost differential should, therefore, be ignored. The difference in the cost in respect of land, earthwork and lining can, however, be easily worked out and Rajasthan should bear this incremental cost in full. Thus, the cost of Navagam Canal with its design approved by Narmada Control Authority should be shared by the two States as under :—

(a) The cost differential in respect of land, earthwork and lining for the gradient proposed by Gujarat and that now prescribed to the borne by Rajasthan in full.

(b) The actual cost of the canal less (a) above to be shared on cusec mile basis.

17.2.5 The cost of the Main Canal beyond the off-take point of the last channel of Gujarat should be borne entirely by Rajasthan. The cost of branch canals and distribution systems should be borne by the State whose area they would respectively serve.

17.2.6 Of the cost of Unit I—Dam and appurtenant works—the irrigation component is 43.9 per cent. Nineteenth part of this cost component is the share of Rajasthan. Therefore, the share of Rajasthan should be 2.31 say 2.3 per cent of the cost of Unit I. As regards Navagam Main Canal, the actual cost shall be shared by Gujarat and Rajasthan on cusec-mile basis in the first instance. On completion of the work, the share cost shall be adjusted as indicated in paragraph 17.2.4 above. Rajasthan shall credit its share cost each year initially on the basis of budget allotment. This should then be adjusted at the end of the year to actual expenditure. The post construction expenditure on maintenance is not to be considered as cost of construction.

17.2.7 Should any difference arise between Rajasthan and Gujarat on figures of cost in respect of Navagam Main Canal for purposes of sharing the cost, the matter shall be referred to the Narmada Control Authority and on such a reference its decision shall be final and binding.

17.3.1 We have consulted our Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this Chapter. They all advise us that they agree with the conclusion reached in paragraphs 17.1.7 and 17.2.1 to 17.2.7.

ANNEXURE XVII-1

No. 1(6)/62-Policy

GOVERNMENT OF INDIA

Ministry of Irrigation & Power

New Delhi, the 17th April, 1967

27th Chaitra, 1889

To

All State Governments
(Departments dealing with
Irrigation & Power)

Sub :—Apportionment of cost and allotment of reservoir storage space in multi-purpose projects

Sir,

I am directed to say that the question of apportionment of cost and allotment of reservoir storage space for hydro-power, irrigation, navigation and flood control in multi-purpose projects has been engaging the attention of the Government for quite some time and the question has also been considered at the various all India Irrigation & Power Seminars attended by the representatives of the Central & State Governments and by the special committees set up for the purpose. In the light of these discussion, procedure has been drawn up for the apportionment of cost and allotment of reservoir storage space as indicated in the succeeding paragraphs which may kindly be adopted by the State Government.

I. (1) A uniform method of cost allocation should be made applicable to all projects.

(2) The cost of multipurpose river valley projects should normally be allocated to only three main functions viz. (i) irrigation, (ii) power and (iii) flood control. The other functions, like water supply for domestic or industrial uses, navigation, pisciculture, recreation and wild life protection, etc. should be included in one of these three functions. The share of cost, and any revenue that the project derived from these subsidiary functions, should be accounted for in the share of the same functions. However, where the cost of any of the subsidiary functons exceed 10% of the total cost of the project such a function should be treated as an additional main function and cost allocated to it separately.

(3) Mainly, there are three methods of allocation in vogue :

(i) Alternative justifiable expenditure method ;

(ii) Separable costs remaining benefits method; and

(iii) Facilities used method.

The "facilities used" method for allocation of the joint costs is recommended. Of the several ways of assessing the facilities used, the following two most common ones, individually or in combination as required, may be adopted.

(i) Reservoir capacity used by each purpose; and

(ii) The quantity of water utilised for each purpose.

(4) The capacity of the reservoir or the quantities of water used for different functions, suitably weighted by consideration of adjustments made in the pattern of releases in the interest of these functions, should be the basis for allocation of common costs. Such distribution of costs among various function has to be done for each unit, like dam, canal, weir, etc. separately and not for the project as a whole.

(5) In case where the benefits in respect of a particular function are not commensurate with the costs so debitable, suitable adjustments may be made between the allocation of common costs.

(6) A review of the costs allocated to the functions would be justified if and when there is significant change in the use of facilities by the various functions concerned.

II. *Stage construction in a valley development.* When phased development of a project is envisaged cost allocation should be done on the basis of proposals to be implemented immediately. When subsequent phase of development of a scheme takes place, the cost should be reallocated accordingly. Re-allocation should also be done when the scope of the project is modified. In case one of the functions of a project gets deferred, the specific cost incurred for that function only together with the interest thereon, should be charged to it and the joint cost should be re-allocated when the deferred function comes into operation. At the time of such re-allocation, the joint cost should be taken the sum at charge at that time or the original joint cost modified on the basis of the then current construction cost index, whichever is less.

III. *Multipurpose projects concerning more than one State.* The basis of allocation should be the same whether the beneficiary is one State or more than one State.

IV. *Variation in allocation when completion costs and full benefits are firmly evaluated.* The cost allocation should be done at the time of finalisation of the estimates but should be readjusted according to actual expenditure on the completion of the project.

V. *Agency for determining allocation.* The partners in the project should determine the cost allocation. In case of disagreement among them, the matter should be referred to a party acceptable to all concerned.

VI. *Cost of allocation when the capacity reserved for flood is put to use durig non-flood season.* Encroachment on space reserved for floods should not be permitted during the specified flood season. But if, after the specified flood season the inflow is more than the withdrawal, the reservoir space earmarked for floods may be utilised for other purpose by agreement. No extra cost should be debitable to other functions for such except when :

(i) project provides for filling in the space reserved for flood control after the end of the specified flood season;

OR

(ii) the filling of a portion of the flood space, subsequently agreed upon, is more or less on an assured basis.

It is requested that the manner of allocation of costs and the specific allocations suggested should be clearly indicated in the project reports which are sent to the Government of India for approval of the schemes.

Yours Faithfully,
Sd/- G.K. DOGRA
Deputy Secretary to the Govt. of India

Copy forwarded for information and guidance to :
All Control Boards

Sd/- R.L. MOHAN
Under Secretary to the Govt. of India

ANNEXURE XVII-2

Use of Water from Sardar Sarovar for Irrigation and Power Generation

Ten years from the commencement of construction of Narmadasagar and Sardar Sarovar dams, besides the completion of these two, there would be Tawa, Barna, Bargi, Kolar and Sukta vide Madhya Pradesh's CMP 116 of 1977. At that stage the utilisation of Narmada water in Madhya pradesh would be 6.00 MAF vide above referred CMP. As Navagam Main Canal is also expected to be ready by then, Rajasthan would be able to, draw its full share of water of 0.5 MAF. Gujarat has envisaged full development of irrigation in a period of 30 years from the commencement of construction *vide* Exhibit G-177, Volume IV, pp. 449-450. Full utilisation of its share of Narmada water by Madhya Pradesh is expected in 45 years from the commencement of construction. Water use is, therefore, considered in three stages, namely at 10 years, 30 years and 45 years of the date of commencement of construction.

A. *After Ten Years from Commencement of Construction,*

1. Yield of the catchment of 75% dependability . . . . . 27.01 MAF

2. Drawn into Navagam Canal

(i) For Gujarat

Total CCA

(Vide Exhibits G-630 & 630-A/1) . . . . . 54.05 lakh acres

CCA served (Vide Exhibit G-177 Vol IV, p. 447) . . . . . 15.33 lakh acres

Water use $\frac{9 \times 15.33}{54.05} = 2.553$ say 2.55 MAF

(ii) For Rajasthan . . . . . 0.50 MAF

Total . . 3.05 MAF

3. Utilisation by Madhya Pradesh

Actual use	6.0 MAF	
Regeneration		
6 × 2.13*		
18.25	0.7 MAF	
Net use		5.30 MAF

(*See Statement 11.4 of Height of Sardar Sarovar Dam)

4. Utilisation by Maharashtra

Actual use	0.25 MAF	
Regeneration	0.02 MAF	
Net use		0.23 MAF

5. Evaporation loss from reservoirs (See Annexure XVII-3) . . . . . 2.13 MAF

6. Water let down into the river
=27.01—(3.05+5.30+0.23+2.13)= 16.30 MAF

B. *After 30 years from commencement of construction*

1. Inflow of 75% dependability . . . . . 28.00 MAF
2. Utilisation by Madhya Pradesh (by linear interpolation) . . . . . 13.00 MAF
3. Available from Madhya Pradesh's share
18.25—13.00=5.25 MAF
Less 10% regeneration=0.52 MAF
4.72 MAF
4. Water taken into Navagam Canal . . . . . 9.50 MAF
5. Water let down into the river . . . . . 4.73 MAF

C. *After 45 years from commencement of construction.*

1. Drawn into Navagam Canal . . . . . 9.50 MAF
2. Let down into the river . . . . . Nil

The water use for irrigation and power is thus as under :—

(MAF)

	Irrigation	Power		
		CHPH	RBPH	Total
After 10 years	3.05	3.05	16.30	19.35
After 30 years	9.50	9.50	4.73	14.23
After 45 years	9.50	9.50	..	9.50

The aggregate water use for the two purposes, irrigation and power, over a period of 110 years (allowing 10 years for construction) works out as under :—

Period from commencement of consctruction	Irrigation		Power use	
10 to 30	$\frac{3.05+9.50}{2} \times 20$	125.5	$\frac{19.35+14.23}{2} \times 20$	335.8
30 to 45	$\frac{9.50+9.50}{2} \times 15$	142.5	$\frac{14.23+9.50}{2} \times 15$	178.0
45 to 110	$\frac{9.50+9.50}{2} \times 65$	617.5	9.50×65	617.0
	Total	885.5		1134.3

Hence percentage use for the two purposes is as under :—

Irrigation $\frac{885.5 \times 100}{885.5+1131.3}$ = 43.9 per cent

Power $\frac{1131.3 \times 100}{885.5+1131.3}$ = 56.1 per cent

ANNEXURE XVII-3

Evaporation loss from Reservoirs after Ten Year of Commencement of Construction of Narmadasagar & Sardar Sarovar Dams (Ref : CMP 116/77-NWDT)

1. The evaporation loss from the reservoirs of major projects which are expected to be completed by then is as under :—

Name of projects	Evaporation loss
	MAF
Narmadasagar	0.88
Tawa	0.22
Barna	0.06
Bargi	0.25
Kolar	0.02
Sukta	0.01
Total	1.44

2. Evaporation loss from medium, micro-minor & pumping schemes = 15% of use

$$= \frac{15}{100} \times 1.25$$

= 0.1875 MAF

say 0.19 MAF

3. Evaporation loss from Sardar Sarovar (FRL 455') = 0.5 MAF

Total evaporation loss = 1.44 + 0.19 + 0.5 = 2.13 MAF

CHAPTER XVIII

DIRECTIONS REGARDING SETTING UP OF MACHINERY FOR IMPLEMENTING THE DECISIONS OF THE TRIBAL

18.1.1 We propose in this Chapter to examine the important question of setting up a machinery for regulating the allocation of Narmada waters to the States concerned and otherwise to implement the decision of the Tribunal.

18.1.2 This is the subject matter of issue No. 14 which states :—

> "What machinery, if any, should be set up to make available and regulate the allocation of waters to the States concerned, or otherwise to implement the decision of the Tribunal ?"

18.1.3 In our opinion, the Tribunal has undoubted jurisdiction under the Inter-State Water Disputes Act (Act No. 33 of 1956) to set up a machinery for carrying out the decisions of the Tribunal with regard to the apportionment of the Narmada waters among the various States, for distribution of electric power benefits, for timely releases of Narmada waters from upstream reservoirs to meet the requirements of Sardar Sarovar, for sharing of the distress among the concerned States in the event of the waters of the Narmada falling short of the allocated quantum and so on. As we have already pointed out, Article 262 of the Constitution states that Parliament may, by law, provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley. In pursuance of this constitutional provision, Parliament enacted the Inter-State Water Disputes Act, 1956, to provide for the adjudication of disputes regarding the waters of inter-State rivers and river valleys. This Act contemplates the constitution of a Tribunal under section 4 and reference of the dispute to the Tribunal so constituted under section 5. Under section 6 of the Act, "the decision of the Tribunal shall be final and binding on the parties to the dispute and shall be given effect to by them". As contemplated in Article 262 of the Constitution, section 11 of the Act further provides that "notwithstanding anything contained in any other law, neither the Supreme Court nor any other Court shall have or exercise jurisdiction in respect of any water dispute which may be referred to the Tribunal under this Act". It is manifest upon a reading of these provisions that Parliament intended by the enactment of the 1956 Act that the water dispute between the disputing States should be finally resolved by the adjudication of the Tribunal and that the decision of the Tribunal was binding upon the party States who shall give effect to it. It is manifest that the final and binding adjudication of the water dispute can only be made by a Tribunal which has the necessary power to make its decision effective by setting up a controlling body or authority for its implementation. It is true that the 1956 Act in terms does not state that the Tribunal may set up such an authority but such a power is necessarily implied from the language of the Act. In our opinion, the express power granted to the Tribunal by the Parliament to investigate the water dispute between the States and give a binding decision thereon involves by necessary implication that the Tribunal is granted the power to do everything which is indispensable for carrying out its decision. The principle is expressed in the maxim : *"Quando aliquid mandatur, mandatur, et omne per quod pervenitur ad illud."* (11 Rep. 52). Dealing with the Doctrine of Implied Powers, Pollock C. B. observed in MICHEALY PENTON & JAMES FRASER v. JOHN STEPHEN HEMPTON.[1]

> "The validity of the appellant's argument must depend as my decision also must depend upon the application of the legal maxim : *'Quando lex aliquid concedit concedere videtur et illud sine quo res ipsa esse non potest.'* It becomes therefore all important to consider the true import of this maxim, and the extent to which it has been applied. After the fullest research which I have been able to bestow, I take the matter to stand thus : Whenever anything is authorised and especially if, as a matter of duty, required to be done by law, and it is found impossible to do that thing unless something else not authorised in express terms be else done, then that something will be supplied by necessary intendment."

18.1.4 The principle is that where the Act confers a jurisdiction it also confers by necessary implication the power of doing all such acts or employing all such means as are essentially necessary to its execution. In other words, the Doctrine of Implied Powers can be legitimately invoked when it is found that a duty has been imposed or a power conferred on authority by statute and it is further found that that duty cannot be discharged or the power cannot be exercised effectively unless some auxiliary or incidental power is assumed to exist. In our opinion, therefore, the Tribunal has jurisdiction in the circumstances of the present case to give necessary directions to the party States for setting up a machinery to ensure that the decision of the Tribunal is faithfully implemented by the States concerned.

18.1.5 Shri Nariman on behalf of Maharashtra, Shri Chitale for Madhya Pradesh and Shri Thakore for Gujarat are unanimously agreed that this repre-

[1] (1858) 117 R.R. 32, 41, 11 Moore's P.C. 347.

sents the correct position in law and that the Tribunal has the jurisdiction in the present case to set up a machinery for implementing its decision and for carrying out the directions contained therein. Shri K. K. Jain for Rajasthan also agreed with this view.

Form of the Machinery

18.2.1 As regards the exact form which this machinery should take, there were differences of view-point between the party States. The draft of the proposed machinery suggested by Maharashtra is contained in its Written Submission 48-A and Maharashtra Statement 15. The proposals of Madhya Pradesh with regard to draft machinery are contained in Madhya Pradesh Statement 132 and 140. The draft of the proposed machinery suggested by Gujarat is contained in its Written Submission 44 and Gujarat Statement 52. The proposal of Rajasthan is contained in its Written Submission 10 and CMP 14 of 1975, Annexure V.

Regulations and water accounting

18.3.1 With respect to Regulations and Water Accounting, all the party States have submitted their draft rules. Madhya Pradesh has submitted M. P. Statement 139 along with CMP .196/77. The document filed by Maharashtra is MR-152 submitted with CMP 166/77. Rajasthan has filed Exhibit R-298 and R-298(a) along with CMP 292 of 1977. The comments of Gujarat are contained in Gujarat Statement 56.

Agreement of the Union of India

18.4.1 In CMPs 234 of 1977 dated 7-9-1977 and 261 of 1977 dated 13-10-1977, the Union of India has expressly agreed to participate in the machinery to be established by the Tribunal if so directed and to do its best to implement the decision of the Tribunal.

Claim of Rajasthan to be a Member of the Narmada Control Authority

18.5.1 It is necessary at this stage to deal with the contention of Maharashtra and Madhya Pradesh that Rajasthan is not entitled to be a Member of the Narmada Control Authority, which is to be set up for carrying out the decision of the Tribunal. In support of its contention, Maharashtra referred to the decision on the preliminary issues dated 23rd February 1972 wherein the Tribunal held that Rajasthan, being a non-riparian State, was not entitled to a share of the waters of the inter-State river Narmada. But in its subsequent decision dated 8th October 1974, the Tribunal pointed out that the legal position has changed as a result of the Agreement between the party States dated 12th July, 1974. As a result of the agreement, Rajasthan has now become entitled to a share of the Narmada waters to the extent of 0.5 MAF. It was further pointed out that the most satisfactory settlement of an inter-State water dispute is by agreement and once there is such an agreement, *that itself furnishes the law governing the rights among the party States.* (See page 10, paragraph 14 of the Indus Commission Report, Volume I). The same principle was enunciated in the judgement of the International Court of Justice, 1937, in the Meuse Dispute between Holland and Belgium.[2]

[2] P.C.I.J. Series A/B No. 70, 1937.

The real question to be answered therefore is whether on a proper interpretation of the agreement of 12th July 1974, Rajasthan is entitled to be a full-fledged Member of the Machinery to be set up by the Tribunal. It was pointed out on behalf of Rajasthan that under Clause 4 of the Agreement Rajasthan was allotted 0.5 MAF of Narmada water for use in its territory and under Clauses 7 and 8, the height of the Navagam Dam and level of the Canal were to be fixed by the Tribunal after taking into consideration the various contentions and submissions of the parties hereto, that is to say, of all the party States including Rajasthan.

18.5.2 Clause 9 of the Agreement reads as follows :—

> "That in the light of this Agreement, issues 4, 5, 7, 7(a), 7(c), 7(d), 7(e), 7(f), 8, 10, 11, 12 and 20 framed by the Tribunal on 28th January, 1971 may be deleted and that issues 6, 7(b), 13 and 17 may be suitably modified as in the annexure to this agreement. All other issues may be determined by the Tribunal after taking into consideration the various contentions and submissions of the parties hereto."

18.5.3 Clause 12 states :—

> "That Rajasthan shall be a party to the further proceedings before the Tribunal, without prejudice to the legal position regarding the rights of a non-riparian State."

18.5.4 It is apparent from Clause 9 that Rajasthan was given the right under the agreement to put forward its contentions and submissions before the Tribunal not only with regard to 0.5 MAF of Narmada water allotted under Clause 4 but also *with regard to the question of apportionment of excess waters under issues 9 and 9A.*

18.5.5 On behalf of Maharashtra and Madhya Pradesh it was said that the phrase "without prejudice to the legal position regarding the rights of the non-riparian State" in Clause 12 meant that Rajasthan was not intended to be a full-fledged party in the proceedings before the Tribunal. In our opinion there is no warrant for this argument. As we have already pointed out, Clauses 4, 6, 7, 8 and 9 of the agreement give an *equal* right to Rajasthan with the other three party States to participate in the proceedings of the Tribunal and *argue all the issues* arising between the party States. In our opinion, the expression in Clause 12 of the agreement construed in the context of the other important clauses of the agreement, that is, clauses 4, 6, 7, 8 and 9 should be properly interpreted to mean that Rajasthan shall be a party to all further proceedings notwithstanding the general legal position regarding the rights of the non-riparian States laid down by the Tribunal in its judgement dated 23rd February 1972.

Agreement of the Four Party States dated 12th July, 1974

18.5.6 This interpretation of Clause 12 of the agreement dated 12th July 1974 is also supported by the

subsequent conduct of the party States. On 16th March 1975, Madhya Pradesh, Gujarat, Maharashtra and Rajasthan further entered into an agreement with regard to execution of certain irrigation projects in the Narmada basin by Madhya Pradesh and in Gujarat. This Agreement is Exhibit MP-566 and reads as follows :—

> "It is agreed that the development of the Narmada Waters should no longer be delayed in the best national interest. The party States to the dispute, therefore, agree to co-operate with the Tribunal in giving the decision at the earliest.
>
> 2. Without prejudice to the decision of the Narmada Water Disputes Tribunal and also without prejudice to the claims of the four party States, namely, Madhya Pradesh, Gujarat, Maharashtra and Rajasthan,
>
> (i) Gujarat may go ahead with the construction of Karjan, Heran, Rami and Sukhi projects subject to usual scrutiny and approval by the Government of India. Maharashtra has small catchment area in Karjan sub-basin. Maharashtra will be allowed to utilise Karjan waters from its catchment in Maharashtra.
>
> (ii) Madhya Pradesh may go ahead with Kolar, Bichia, Sukta and Bichhua-Latia projects subject to the usual scrutiny and approval of the Government of India.
>
> New Delhi the 8th March, 1975. Sd/- Jagjivan Ram, Union Minister of Agriculture and Irrigation.
>
> Sd/- H. C. Sarin, Advisor to Governor, Gujarat.
>
> Sd/- P. C. Sethi, Chief Minister of Madhya Pradesh.
>
> Sd/- Harideo Joshi, Chief Minister of Rajasthan.
>
> Sd/- K. N. Singh, Deputy Minister of Agriculture & Irrigation."
>
> Sd/- Vasant Rao Patil, Minister for Irrigation, Maharashtra.

18.5.7 It is well-established that even if there is a doubt as to the meaning of a provision contained in a Treaty the relevant conduct of the contracting parties after the conclusion of the Treaty has a high probative value as to the intention of the parties at the time of its conclusion. The point is well-stated in the Comment on Article 19 of the Harvard Research Draft Convention (at page 966)[3] :—

> "In interpreting a treaty, the conduct or action of the parties thereto cannot be ignored. If all the parties to a treaty execute it, or permit its execution, in a particular manner, that fact may reasonably be taken into account as indicative of the real intention of the parties or of the purpose which the instrument was designed to serve."

18.5.8 The practice is recognised by Rousseau[4] under the title Prise en consideration de l'attitude des Parties, of which he writes :—

> "11 Arrive assez frequemment que la jurisprudence internationale procede a l'interpretation d'un traite d'apres l'application qui en a ete faite par les Parties contractantes, cette attitude revelant l'interpretation qui en fait a ete effectivement suivie par les auteurs du traite."

18.5.9 In 1928 in its Advisory opinion on the Jurisdiction of the Courts of Danzig the Permanent Court made the remark[5] :

> "The intention of the Parties, which is to be ascertained from the contents of the Agreement, taking into consideration the manner in which the Agreement has been applied, is decisive. This principle of interpretation should be applied in the present case."

18.5.10 In the Chamizal Arbitration in 1911[6] it was necessary to construe two American-Mexican boundary treaties of 1848 and 1853 ; and in that context the members of the Tribunal found it,

> "impossible to come to any other conclusion than that the two nations have, by their subsequent treaties and their consistent course of action in connection with all cases arising thereunder, put such an authoritative interpretation upon the language of the Treaties of 1848 and 1853 as to preclude them from now contending that the fluvial portion of the boundary created by those treaties is a fixed line boundary."

18.5.11 For these reasons we are of the opinion that Clause 12 of the Agreement dated 12th July, 1974 construed along with Clauses 4, 7, 8 and 9 of the same agreement must be interpreted to mean that the intention of the party States was that Rajasthan should be a full-fledged party to all further proceedings before the Tribunal. We accordingly reject the argument of Maharashtra and Madhya Pradesh on this aspect of the case and hold that Rajasthan is entitled to be a Member of the Machinery to be set up by the Tribunal with the same rights and obligations as the other three party States.

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[3] Research in International Law on Treaties supplement to 29 American Journal of International Law, October 1935.

[4] Rousseau—Principe Genera de droit international Publis (1944) (pp. 704-707).

[5] Series B, No. 15 at p. 18.

[6] Hudson—Cases on International Law (3rd Edn) 1951, pp. 267, 269.

18.6.1 Having examined the view-points of the party States, we give the following directions :—

PART A

MACHINERY FOR REGULATION AND CONTROL OF THE NARMADA WATERS

Clause I : Constitution of the Authority

Clause 1(1) : An inter-State administrative authority to be called Narmada Control Authority (hereinafter referred to as the 'Authority') shall be established for the purpose of securing compliance with and implementation of the decision and directions of the Narmada Water Disputes Tribunal (herein referred as the 'Orders').

Clause 1(2) : The Authority shall consist of seven high-ranking Engineer Members, of whom one each shall be of the rank of Engineer-in-Chief, Chief Engineer, or Additional Chief Engineer of the Irrigation Department appointed by the Government of each of the States of Madhya Pradesh, Gujarat, Maharashtra and Rajasthan and three other eminent Engineers of a rank not less than that of a Chief Engineer, to be appointed by the Central Government in consultation with the party States. One of the three Independent Members shall be nominated by the Central Government, as the Chairman of the Authority with a deliberative vote at meetings where decisions are taken on any matter affecting the interest of more than one State and he will be in charge of the administrative work of the Authority. The Central or State Government, as the case may be, shall have the power to remove or suspend from the Authority any Member who in its opinion is not suitable to continue as Member.

Clause 1(3) : Each Independent Member shall be full-time Member and be appointed for a term not exceeding five years. The Members appointed by the State Governments shall be part-time Members. The appointing authority for independent Member or that for part-time Member, as the case may be, shall determine the terms and conditions of appointment in each case. As far as practicable, the first appointment of the seven members of the Authority shall be made within three months from the date of publication of the decision of the Tribunal in the Official Gazette.

Clause 1(4) : *Vacancies of Members* : On any vacancy occuring in the offices of the three independent Members, the Central Government shall appoint a person to such vacant office, and on any vacancy occuring in the office of the four Members other than the independent Members, the State Government by whom the Member whose office falls vacant was appointed shall appoint a person to the vacant office.

In case of illness or absence for any cause whatever of a Member, the Central Government or State Government by whom he was appointed (as the case may be) may appoint a person as an Acting Member during such illness or absence and the Acting Member shall while so acting have all the powers and perform all the duties and be entitled to the indemnities of the Member (vide Clause 5) in whose stead he so acts, save and except that the next senior independent Member appointed by the Central Government and not the Acting Member shall act as Chairman at business meetings of the Authority or as the Chairman of the Authority in the event of illness or absence of the Chairman of the Authority.

Clause 2 : *Secretary of the Authority* : The Authority shall employ a Secretary, who shall be an Engineer. He shall not be a Member of the Authority.

Clause 3 : *Quorum and Voting* : Five Members shall be a quorum and the occurrence of the majority shall be necessary for the transaction of the business of the Authority except such business as the Authority may from time to time prescribe as routine. The Authority shall not prescribe as routine any business in which the interests of any two of the States are likely to be in conflict. For the transaction of routine business three Members shall be a quorum and in the absence of the Chairman of the Authority, the Chairman elected at the meeting shall have a deliberative vote and in the event of an equality of votes a casting vote also.

Subject as aforesaid the Members shall have equal powers.

Clause 4 : *Disposal of business by the Authority* :

Clause 4(1) : Subject to the provisions of Clause 4(2) below, the Authority may dispose of any matter before it either by circulation or by holding a meeting. However, it will be open to any Member of the Authority to require that a matter shall not be disposed of by circulation but at a meeting.

Clause 4(2) : On the following matters the Authority shall record its decision by a Resolution at a meeting in which the Chairman and all the Members from the party States are present :—

(i) Framing of Rules of Business ;

(ii) Delegation of functions to a Member or Secretary or any official of the Authority ;

(iii) Categorising any part of the business of the Authority as of a formal or routine nature ;

(iv) Any other matter which any of the four party States require that it shall be decided at a meeting where all the members from the party States are present.

Clause 4(3) : Subject to the foregoing provisions, the Authority shall frame its own Rules for the conduct of its business.

Clause 4(4) : The Authority shall cause proper minutes or records of all its proceedings to be kept as a permanent record.

Clause 5 : *Indemnity of Members* : No Member, officer or employee of the Authority shall be liable for loss, injury or damage resulting from (a) action taken by such Member, Officer or employee in good faith and without malice under the apparent authority of the Orders, even though such action is later determined to be unauthorised, or (b) the negligent or wrongful act or omission of any other person, employed by the Authority and serving under such Member, officer

or employee unless such Member, officer or employee failed to exercise due care in the appointment of such other person or the supervision of his work.

Clause 6 : *Officers and Servants of the Authority* : The Authority may from time to time appoint or employ such and so many officers and servants as it thinks fit and remove or dismiss them, under the rules and regulations applicable to the appointment, removal and dismissal of the Central Government officers and servants. All such officers and servants shall as such be subject to the sole control of the Authority. The scales of pay and other service conditions shall be as applicable to Central Government employees.

Persons employed in the services of the four States may be appointed or employed by the Authority in such proportions as the Authority may deem fit. The Authority shall arrange with the State Governments to spare the services of the persons employed in the State Governments for whole-time employment with the Authority, or for the performance of any work or services for the Authority. The Authority may also make direct recruitment of any personnel or obtain the same from the Centre or other sources as considered appropriate.

Clause 7 : *Administrative & Field Organisation* All expenses of the Authority (including the salary and expenses of the independent Members) shall be borne by the State Governments of Madhya Pradesh, Gujarat, Maharashtra and Rajasthan in equal shares. The expenses pertaining to a Member representing a State shall be borne by the State concerned. The cost of maintaining, operating and controlling the gauging and other hydrological stations in each State and the tele-communication systems for communicating the data shall be borne by the State concerned. The costs of construction and maintenance of the storages, power installations, diversion works, head works and canal net works shall be borne wholly by the State Government in whose territory the works are located or shared in case the benefits are shared.

Clause 8 : *Powers, Functions and Duties of the Authority* : 8(1) The Role of the Authority will mainly comprise co-ordination and direction. Normally all bilateral matters should be dealt with mutually by the States concerned and referred to the Authority only if there is a dispute.

8(2) The Authority shall be charged with the power and shall be under a duty to do any or all things necessary, sufficient and expedient for the implementation of the Orders with respect to :

(i) The storage, apportionment, regulation and control of the Narmada waters ;

(ii) sharing of power benefits from Sardar Sarovar Project ;

(iii) regulated releases by Madhya Pradesh ;

(iv) acquisition by the concerned State for Sardar Sarovar Project of lands and properties likely to be submerged under Sardar Sarovar ;

(v) compensation and rehabilitation and settlement of oustees ; and

(vi) sharing of costs.

8(3) In particular and without prejudice to the generality of the foregoing functions, the Authority shall perform *inter alia* the following functions :—

(i) Madhya Pradesh or Gujarat, as the case may be, shall submit to the Authority the Sardar Sarovar Project Report, the Narmadasagar Project Report, the Omkareshwar Project Report and the Maheshwar Project Report. The Authority shall point out to the States concerned, the Central Water Commission and Planning Commission any features of these projects which may conflict with the implementation of Orders of the Tribunal. Any subsequent changes in the salient features or substantial increase in cost in respect of dams, powerhouses and canal headworks shall be reported to the Authority for taking appropriate action in the matter.

(ii) The Authority shall decide the phasing and shall co-ordinate construction programmes of the Narmadasagar and Sardar Sarovar projects with a view to obtaining expeditiously optimum benefits during and after the completion of the construction of the projects, having due regard to the availability of funds.

(iii) The Authority shall obtain from the concerned States periodical progress reports both as to works and expenditure, and shall on receipt of such reports review the progress of construction of different units of the projects and whenever necessary advise the State concerned on the steps to be taken to expedite the work. The States shall submit, in respect of projects in Clause 8(3)(i), completion reports to the Authority.

(iv) The Authority shall issue appropriate directions whenever necessary for timely and full compliance by the concerned States with the Orders of the Tribunal in the matter of acquisition for and making available to Gujarat lands and properties likely to be submerged under the Sardar Sarovar Project and in the matter of compensation and rehabilitation of oustees thereunder.

(v) The Authority shall cause to be established, maintained and operated by the State Governments concerned or any one or more of them, such stream and other gauging stations, equipped with automatic recorders where necessary, discharge, silt and evaporation observation stations and measuring devices as may be necessary from time to time for securing the records required for carrying out the provisions of the Orders. If deemed necessary, the Authority may require the installation, maintenance and operation by the State concerned of measuring devices of approved type at the head of main canals as also at the offtake of the canal for Rajasthan for measuring amount of water diverted from Narmada river system.

(vi) Concurrent records shall be kept of the flow of the Narmada at all stations considered necessary by the Authority and the records correlated.

(vii) The Authority shall frame rules of regulation and water accounting as per guidelines given in Chapter XV. It shall determine the share of water of each State for every ten-day period for purposes of regulation and water accounting.

(viii) The Authority shall ensure implementation of the Orders of the Tribunal in respect of (a) quantum and pattern of regulated releases by Madhya Pradesh ; (b) payment for such regulated releases/sharing of costs.

(ix) The Authority shall collect from the States concerned data of the areas irrigated by Narmada waters in each season, of power generated at each hydro-electric power station at and downstream of Narmadasagar, of withdrawals for domestic, municipal and industrial or any other purposes and of waters going down the river from Sardar Sarovar Project.

(x) The Authority shall determine the volume of water flowing in the river Narmada and its tributaries in a water year (1st July to 30th June next year).

(xi) The authority shall determine from time to time the volume of water stored by each State in reservoirs and other storages and may for that purpose adopt any device or method.

(xii) The Authority shall determine at appropriate periodic intervals the use of Narmada waters made by the States, or such of them as necessary, at any place or in any area at any time and for that purpose it may take note of all diversions or obstructions, whether natural or artificial or partly natural and partly artificial, from the river Narmada and its tributaries and measure such use by any method as it deems fit.

(xiii) The Authority or any of its duly authorised representative shall have power to enter upon any land and property upon which any project or development of any project, or any work of gauging, evaporation or other hydrological station or measuring device has been or is being constructed, operated or maintained by any State for the use of Narmada water. Each State through its appropriate departments shall render all co-operation and assistance to the Authority and its authorised representatives in this behalf.

(xiv) The Authority shall meet as often as necessary and decide on a proper management of waters including in particular the manner and details of withdrawals of waters from the storages on the Narmada river system in accordance with the Orders. In particular, the Authority shall meet at the end of filling season, and review the availability of waters in the storages on the Narmada river system and decide upon the pattern of their regulation for the next irrigation season, taking into account the carryover storages.

(xv) The Authority shall give directions for a phased programme of construction for generation and transmission of power in fulfilment of the shares of power allocated to the three States of Madhya Pradesh, Maharashtra and Gujarat from Sardar Sarovar and for payments therefor in accordance with the Orders of the Tribunal. The Authority shall also ensure that generation and transmission of power from Sardar Sarovar complex are in accordance with the Orders.

(xvi) The Authority shall issue appropriate directions for the establishment, maintenance and operation of an effective system of flood forecasting and flood control, including reporting of heavy precipitation, and telecommunication systems. The safety of a structure shall primarily be the responsibility of the Chief Engineer incharge of the structure and no decision or order shall be binding on him if in his opinion the safety of the structure will be endangered thereby. The Authority shall publish annually and make available to party States the data regarding operation of reservoirs during floods.

Clause 8(4) : In the light of its experience, the Authority may modify or add to the functions enumerated hereinabove in clause 8(3)(i) to (xvi) by a resolution.

Clause 8(5) : All the concerned States shall submit to the Authority all the relevant information called for by the Authority in connection with the Narmada Valley Development expeditiously and within reasonable time.

Clause 9 : *Annual Report of the Authority* : The Authority shall prepare and transmit to each of the four States as early as possible and in any case before the end of the current Water Year (1st July to 30th June) an Annual Report covering the activities of the Authority for the preceding year and to make available to each State on its request any information within its possession any time and always provide access to its record to the States and their representatives.

Clause 10 : *Records of the Authority and their location* : The Authority shall keep a record of all meetings and proceedings, maintain regular accounts, and have a suitable office where documents, records, accounts and gauging data shall be kept open for inspection by the four States or their representatives at such times and under such regulations as the Authority may determine. The location of the Central, regional and sub-regional offices of the Narmada Control Authority shall be determined by the Authority.

The headquarters of the Authority shall be at New Delhi till such time as it decides on its permanent location.

Clause 11: *Contracts and Agreements* : The Authority shall enter into such contracts and agreements as may be necessary and essential for the full and proper performance of the functions and duties conferred or imposed on it.

Clause 12 : *Financial Provisions* : (1) All the capital and revenue expenditure required to be incurred by the Authority shall be borne by the four States of Madhya Pradesh, Gujarat, Maharashtra and Rajasthan equally. The Governments of the four States shall provide the necessary funds to the Authority to meet all capital and revenue expenditure required to be incurred by the Authority for the discharge of its functions.

(2) On the constitution of the Authority each of the Governments of the four States shall contribute Rs. 5,00,000 (Rupees five lakhs) to the fund of the Authority in the first instance.

(3) The Authority shall in the month of September of each year prepare detailed estimate of the amounts of money required during the twelve months from the first day of April of the ensuing year, showing the manner in which it is proposed to expend such money. The Authority shall on or before the fifteenth of October forward a copy of such detailed estimate to the concerned Chief Engineers of the four States and indicate the amounts required to be contributed by each State for the ensuing financial year. Each of the State Governments shall pay to the Authority its contribution as indicated by the Authority on or before the 30th day of April of the ensuing year.

(4) The Authority shall maintain detailed and accurate accounts of all receipts and disbursements and shall after the close of each financial year prepare an Annual Statement of Accounts and send copies thereof to the Accountants General as well as the concerned Chief Engineers of the four States. The form of the Annual Statement of Accounts shall be such as may be prescribed by rules. The Accounts maintained by the Authority shall be open for inspection at all reasonable times by the four States through their duly authorised representative or representatives.

(5) Disbursements shall be made from the fund of the Authority only in such manner as may be prescribed by the Authority. The Authority may incur such expenditure as it may think fit to meet any emergency in the discharge of its functions.

(6) The accounts maintained by the Authority shall be audited by the Comptroller and Auditor General of India or his nominee, who shall certify subject to such observations as he may wish to make on the annual accounts of the Authority. The Authority shall forward to the Accountants General and the concerned Chief Engineers of the four States copies of the Report of the Comptroller and Auditor General of India and shall include the same in its Annual Report.

Clause 13 : *Decision of the Authority* : The decisions of the Authority on all matters covered under clause 8 shall be final and binding on the four party States. However, there shall be a Review Committee which may *suo motu* or on the application of any party State review any decision of the Authority.

Clause 14(1) *Review Committee* : The Review Committee shall consist of five Members including a Chairman as under :—

(i)	Union Minister for Irrigation as the :	Chairman
(ii)	Chief Minister of Madhya Pradesh :	Member
(iii)	Chief Minister of Gujarat :	Member
(iv)	Chief Minister of Maharashtra :	Member
(v)	Chief Minister of Rajasthan :	Member

The Secretary of the Union Ministry of Agriculture & Irrigation, Department of Irrigation shall be the Convenor of the Review Committee but shall not have any voting right.

In case there is President's rule in any of the States, the Governor of that State or his authorised representative will act as Member of the Review Committee.

Clause 14(2) The Chief Ministers of the four States may nominate the respective Irrigation Ministers either generally or specially as the alternate Members with full powers of voting, taking decisions etc.

Clause 14(3) : The Review Committee may review the decision of the Authority at a meeting at which the Chairman and all the Members of the Review Committee are present.

Clause 14(4) : Advance notice of the proposed meeting of the Review Committee, its agenda and agenda notes will be forwarded by the Convenor to the party States.

Clause 14(5) : The decision of the Review Committee shall be recorded in writing and shall be final and binding on all the States.

Clause 15 : *Construction, Outside Jurisdiction of Authority* : The construction of the works and the planning of the Projects will be carried out by each State through its own agencies and in the manner such State deems proper without any interference by the Authority or the other States, save and except to the extent as prescribed in the Orders of the Tribunal.

Clause 16 : Nothing contained in this Chapter shall prevent the alteration, amendment or modification of all or any of the foregoing clauses by agreement between all the States concerned.

Clause 17 : In C.M.P. 234 of 1977 and C.M.P. 201 of 1977, the Union of India has consented to participate in the machinery to be established by the order of the Tribunal, if so directed and to do its best to implement the decision of the Tribunal.

In terms of these C.M..Ps, we direct the Union of India to participate in the machinery set up by the order of the Tribunal to implement the directions of the Tribunal specifically under clauses 1(2), 4, 12(6), 13, 14 and generally to implement all the other directions so far as the Union of India is concerned.

18.7.1 We have consulted our Assessors Dr. M. R. Chopra, Shri Balwant Singh Nag and Shri C. S. Padmanabha Aiyar with regard to the subject matter of this Chapter. They all advise us that they agree with the directions contained in paragraph 18.6.1.

CHAPTER XIX

ORDER AS TO COSTS AND OTHER INCIDENTAL MATTERS

Order as to Costs

19.1.1 The Governments of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan shall bear their own costs of appearance before the Tribunal. The expenses of the Tribunal shall be borne and paid by the aforesaid four States in equal share. This is in accordance with the practice followed in the USA as well as the precedent of the Indus Commission Report.

19.1.2 In paragraph 7 of our Order dated 7th May 1976, we mentioned that Madhya Pradesh had pressed that it should be awarded special costs of hearing from 27-1-1976 to 1-4-1976 during which period Madhya Pradesh had argued the matter of soil surveys carried out by Gujarat. Maharashtra likewise stated that it should be awarded special costs of hearing in CMP 87/1976 and connected petitions. Having given further consideration to the matter, we are of the opinion that there is no justification in making an Order as to payment of special costs in this case.

Use of Metric System

19.2.1 The party States have in their submissions, pleadings, arguments and statements given figures mostly in foot-pound-second system. Also, many of the old records produced in evidence have figures in that system. In our Report, we have used the same system for facility of reference. However, we have made our final order in Chapter XX in metric system, indicating at the same time the corresponding figures in foot-pound-second system. Where figures quoted in the two systems do not exactly tally, the figures in metric system shall prevail, except that the figures of 28 MAF, 0.5 MAF and 0.25 MAF as per agreement of the party States shall hold.

Acknowledgements

19.3.1 In the first place, we desire to express our appreciation for the valuable advice and assistance given by our Assessors, Dr. M. R. Chopra, Shri Balwant Singh Nag, Shri C. S. Padmanabha Aiyar, Dr. Ambika Singh and Dr. S. B. Hukkeri.

We are also glad to express our indebtedness to all the learned Counsel appearing on behalf of the party States and the Union of India for the very careful and elaborate arguments they have addressed in this case.

We also desire to express our gratitude to the State Governments of Madhya Pradesh, Gujarat, Maharashtra and Rajasthan for their co-operation and assistance and for the hospitality and courtesy received during our tours and for the arrangement made for our visits to the various dam sites, command areas etc.

We should also like to place on record our appreciation of the excellent work done by the officers and staff, both on the technical and administrative side. Shri P. R. Bose, Secretary of the Tribunal and Shri N. K. Sarma, Technical Director (as also Shri G. S. Bakshi, our previous Secretary) have been conspicuous in the discharge of their respective duties with efficiency and dedication. It would be invidious to mention individuals from among the members of our staff but the Tribunal would like to place on record its high appreciation of the ardous work and single minded devotion displayed by each and every member of the staff.

CHAPTER XX

FINAL ORDER AND DECISION OF THE NARMADA WATER DISPUTES TRIBUNAL

In Chapters I to XIX of the Report, the Chairman of the Tribunal, Shri V. Ramaswami and Member, Shri M. R. A. Ansari have expressed their opinion on all the important issues arising in this case. Shri A. K. Sinha, another Member of the Tribunal, has expressed on certain issues a different opinion which is reproduced in Volume IV of this Report. In accordance with the majority opinion, the Tribunal gives the following Decision and makes the following Order under Section 5(2) of the Inter-State Water Disputes Act 1956 read with Section 5(4) of the same Act :—

FINAL ORDER AND DECISION OF THE TRIBUNAL

Clause I : Date of Coming into Operation of the Order.

This Order shall come into operation on the date of publication of the Decision of this Tribunal in the Official Gazette under Section 6 of the Inter-State Water Disputes Act, 1956.

Clause II : Determination of the Utilisable Quantum of Narmada Waters at Navagam Dam site.

The Tribunal hereby determines that the utilisable quantum of waters of the Narmada at Navagam Dam Site on the basis of 75 per cent dependability should be assessed at 28 Million Acre Feet. (34, 537.44 M. cu. m.)

Clause III : Apportionment of the Utilisable Quantum of Narmada Waters.

The Tribunal hereby orders that out of the utilisable ntum of Narmada waters, (a) Madhya Pradesh is led to a share of 18.25 Million Acre Feet ,511.01 M. cu. m.), (b) Gujarat is entitled to a e 9 Million Acre Feet (11,101.32 M. cu. m.), Rajasthan is entitled to a share of 0.5 Million Acre t (616.74 M. cu. m.) and (d) Maharashtra is itled to a share of 0.25 Million Acre Feet (308.37 cu. m.).

use IV : Order with regard to Excess Waters and Sharing of Distress.

(1) The utilisable flow of Narmada in excess of the 28 Million Acre Feet (34,537.44 M. cu. m.) of utilisable flow in any water year, i.e., from 1st of July to 30th of June of next calendar year is apportioned in the following ratios of allocation, i.e., 73 for Madhya Pradesh, 36 for Gujarat, 1 for Maharastara and 2 for Rajasthan ;

(2) In the event of the available utilisable waters for allocation in any water year from 1st of July to 30th June of the next calendar year falling short of 28 Million Acre Feet (34,537.44 M. cu. m.), the shortage should be shared between the various States in the ratio of 73 for Madhya Pradesh, 36 for Gujarat, 1 for Maharashtra and 2 for Rajasthan ;

(3) The available utilisable waters in a water year will include the waters carried over from the previous water year as assessed on the 1st of July on the basis of stored waters available on that date ;

(4) The available utilisable waters on any date will be inclusive of return flows and exclusive of losses due to evaporation of the various reservoirs ;

(5) It may be mentioned that in many years there will be surplus water in the filling period after meeting the storage requirements and withdrawals during the period. This will flow down to sea. Only a portion of it will be utilisable for generating power at Sardar Sarovar river-bed power-house, and the rest will go waste. It is desirable that water, which would go waste without even generating power at the last river-bed power-house, should be allowed to be utilised by the party States to the extent they can.

Gujarat is, therefore, directed that whenever water starts going waste to sea, without generating power, Gujarat shall inform the Narmada Control Authority (hereinafter referred to as the Authority), with copies to designated representatives of all the concerned States, and Gujarat shall also inform them when such flows cease. During the period of such flows, the party States may utilise them as they like, and such utilisation by the party States will not count towards allotment of supplies to them, but use of such water will not establish any presumptive right.

Clause V : Period of Operation of the Order Of Apportionment.

Our Orders with regard to the equitable allocation in Clauses III and IV are made subject to review at any time after a period of 45 years from the date of the Orders of the Tribunal.

4 A&I/78—17

Clause VI : Full Supply Level of the Navagam Canal.

The Tribunal hereby determines that the Full Supply Level of Navagam Canal offtaking from Sardar Sarovar should be fixed at 91.44 m. (+300′) at its head regulator with a bed gradient of 1 in 12,000 from head to 290 km (mile 180), that is, upto the offtake of Saurashtra branch. From that point to Rajasthan border the bed gradient should be 1 in 10,000. These bed gradients may be changed by Gujarat and Rajasthan by mutual agreement.

Clause VII : Full Reservoir Level and maximum Water Level of the Navagam Dam.

The Tribunal hereby determines that the height of the Navagam Dam should be fixed for Full Reservoir Level +138.68 m, (+455′) and Maximum Water Level at +140.21 m., (+460′).

Clause VIII : Sharing of Costs and Benefits.

(1) The Tribunal hereby determines that out of the net power produced at Navagam at canal head and river bed power houses on any day the share of Madhya Pradesh will be 57 per cent; Maharashtra's share will be 27 per cent and Gujarat's share will be 16 per cent.

(2) The Tribunal makes the following further Orders :—

(i) The power generated in the River Bed and Canal Power Houses at Navagam will be integrated in a common switchyard.

(ii) Madhya Pradesh and Maharashtra will be entitled to get 57 per cent and 27 per cent respectively of the power available at bus bar in the switchyard after allowing for station auxiliaries.

(iii) The above entitlement applies both to availability of machine capacity for peak loads and to the total energy produced in any day.

(iv) The entitlement of power and energy for any day can be utilised fully or partly by the concerned States or sold to another participating State under mutual agreement. It cannot, however, be carried forward except under a separate agreement or working arrangement entered into among the affected parties.

(v) Gujarat will construct and maintain the transmission lines needed to supply the allotted quantum of power to Madhya Pradesh and Maharashtra upto Gujarat State border, along an alignment as agreed to between the parties and if there is no agreement, along such alignment as may be decided by the Narmada Control Authority. The transmission lines beyond Gujarat State border shall be constructed and maintained by Madhya Pradesh and Maharashtra in their respective States.

(vi) The power houses and appurtenant works including the machinery and all installations as well as the transmission lines in Gujarat State will be constructed, maintained and operated by Gujarat State or an authority nominated by the State.

(vii) The authority in control of the Power Houses shall follow the directions of the Narmada Control Authority in so far as use of water is concerned.

(viii) The scheme of operation of the Power Houses including the power required and the load to be catered for to the different party States during different parts of the day shall be settled between the States at least one week before the commencement of every month and shall not be altered during the month except under agreement among the States or under emergencies.

(ix) The capital cost of the power portion of Navagam complex shall comprise the following :—

(a) Full cost of Unit-III electrical works and control works pertaining thereto upto and including the switchyard.

(b) Full cost of transmission lines in Gujarat State constructed for supplying power to Madhya Pradesh and Maharashtra.

(c) 56.1 per cent of the net cost of common facilities such as Dam and Appurtenant Works i.e. Unit I of Sardar Sarovar Project, after allowing for credits, if any.

(d) 56.1 per cent of the credit given to Madhya Pradesh for the downstream benefits derived from Narmadasagar Dam.

(x) Madhya Pradesh and Maharashtra shall respectively pay to Gujarat 57 per cent and 27 per cent of the capital cost of the power portion of the Sardar Sarovar headworks worked out vide (ix) above. This amount shall be paid in annual instalments until the capital works are completed. Each instalment will be worked out on the basis of the budgeted figures of the concerned works at the commencement of each financial year and shall be set off or adjusted against actual figures at the end of the financial year.

(xi) In addition to the payments *vide* (x) above Madhya Pradesh and Maharashtra shall also pay to Gujarat 57 per cent and 27 per cent respectively of the operation and maintenance costs of the Sardar Sarovar Power complex each year. These payments are also to be based on budgeted figures at the commencement of each financial year and adjusted against actual cost at the end of the year.

(xii) Notwithstanding the directions contained hereinabove, the party States may, by mutual agreement, alter, amend or modify any of the directions in respect of sharing of power and payment for it.