

Contents Report Volume - I

Foreword
Preface
Check List
Salient Features
Executive Summary
List of Officers Associated in Preparation of DPR
Index Map

Volume -I - Main Report

Para no.	Particulars	Page No.
	Chapter - 1 Introduction	
1.1	General	1
1.1.1	National perspective for water resources development	1
1.2	Mahanadi-Godavari-Krishna-Pennar-Cauvery-Vaigai-Gundar link scheme	4
1.3	Godavari (Inchampalli) – Krishna (Nagarjunasagar) link canal project	6
1.4	Aim of the link project and description of the works	10
1.5	Location of project area	13
1.6	Communication facilities	15
1.7	General climatic conditions of the states and project area	15
1.8	General topography, physiography and geology of the project area	16
1.9	Population	19
1.10	Occupation	20
1.11	Natural resources	20
1.11.1	Water resources	20
1.11.2	Land resources	21
1.11.3	Agriculture	22
1.11.4	Mineral wealth	23
1.11.5	Industry	23
1.11.6	Tourism	24
1.11.7	Scriptural importance	24
1.11.8	Culture & people	25
1.12	Landuse and socio-economic aspects	25

Para no.	Particulars	Page No.
1.12.1	Cropping pattern	25
1.12.2	Socio-economic aspects	26
1.12.3	Drought prone areas	26
1.12.4	Ground water	27
1.12.5	Water quality	28
1.13	Choice of the project	28
1.13.1	Project planning and optimisation of benefits	31
1.14	Stages / phases of development of the link project	32
1.15	Fitment of the scheme in overall development of the region	32
1.16	Intimation to other development authorities regarding the scheme	33
1.17	Public announcements and public hearings	33
1.18	Interlinking of the scheme with neighbouring schemes	33
1.19	Inter state / international aspects	34
1.20	Cost and benefits of the scheme	34
1.20.1	Cost of the project	34
1.20.2	Benefits from the project	35
1.21	Public cooperation and participation	36
1.22	Provision for domestic and industrial water supply	36
1.23	Methodology	36
1.23.1	Survey & investigations	37
1.23.2	Special studies by other Agencies	37
1.23.3	Technical studies	38
1.23.4	Clearances required	39
1.23.5	Organisation of chapters	40
	Chapter - 2 Physical features	
2.0	General	41
2.1	Geographical disposition	41
2.2	Topography of the basins, reservoirs and command area	42
2.2.1	Topography and physiography	42
2.3	Geology of the basins, reservoirs and command area	50
2.3.1	Geology of the basins and command area	54
2.4	River system and basin characteristics	57
2.4.1	Godavari basin	57
2.4.2	Krishna basin	60
2.4.3	Gundlakamma basin	61
2.4.4	Basin area of streams between Gundlakamma and Pennar	63

Para no.	Particulars	Page No.
2.4.5	Pennar basin	64
2.4.6	Basin area of streams between Pennar and Palar	66
2.4.7	Palar basin	68
2.4.8	Basin area of streams between Palar and Cauvery	70
2.4.9	Cauvery basin	71
	Chapter - 3 Inter-State aspects	
3.0	General	74
3.1	Godavari basin	75
3.1.1	State-wise breakup of catchment	77
3.1.2	Net water availability as per GWDT for Telangana/AP	78
3.2	Various legal aspects on the link project	79
3.2.1	Sharing of Godavari waters among basin states	79
3.2.2	Submergence, PAPs and R&R	85
3.2.3	Existing and proposed projects between Kaleshwaram and Dowlaiswaram	85
3.3	Impact of link project on Tribunal Awards	87
3.4.1	Godavari Water Disputes Tribunal (GWDT) Award	87
3.4.2	Krishna Water Disputes Tribunal - II (KWDT II) Award	89
3.4.3	Pennar river	90
3.4.4	Palar river	91
3.4.5	Cauvery Water Disputes Tribunal (CWDT) Award	91
3.4.6	Supreme court verdict	92
3.5	Provision of water through link project	92
3.6	Impact of Godavari (Janampet)-Cauvery (Grand Anicut) link project on Peninsular Component	93
	Chapter - 4 Surveys and Investigations	
4.1	General	95
4.2	Topographical surveys	96
4.2.1	Canal	96
4.2.2	Cross drainage/cross masonry works	98
4.2.3	Pump house, switch-yards etc.	98
4.2.4	Tunnel	98
4.2.5	Command area	99
4.3	Soil conservation, archaeological and mineral surveys	99
4.4	Geological investigations	99

Para no.	Particulars	Page No.
4.4.1	Godavari (Inchampalli) to Krishna (Nagarjunasagar) (Reach-I) (RD 0.0 km to RD 299.256 km)	100
4.4.2	Krishna (Nagarjunasagar) - Pennar (Somasila) (Reach-II) (RD 299.256 km to RD 692.276 km)	102
4.4.3	Pennar (Somasila) to Palar under Reach-III (RD 692.276 km to RD 906.951 km)	104
4.4.4	Palar to Cauvery (Grand Anicut) under Reach-II I(RD 906.951 km to RD 1210.841 km)	104
4.4.5	Foundation investigations along barrage	105
4.5	Geo physical investigations	109
4.6	Construction materials investigations	109
4.7.1	Soils	110
4.7.2.1	Fine aggregate	111
4.7.2.2	Coarse aggregate	113
4.7.3	Bricks	115
4.7.4	Cement and steel	115
4.8	Soil surveys -Mapping of existing land use/land cover and irrigability	115
4.8.1	Soil	115
4.8.2	Land use/land cover mapping	116
4.8.3	Land use classification	117
4.8.4	Land irrigability classification	117
4.8.5	Land evaluation for crop suitability	121
4.9	Drainage survey	122
4.10	Communication surveys	123
4.11	Hydrological and meteorological investigations	124
4.11.1	Runoff	124
4.11.2	Climate	125
4.11.3	Rainfall	126
4.11.4	Temperature	126
4.11.5	Relative humidity	127
4.11.6	Wind speed	127
4.11.7	Cloud cover	127
Chapter - 5		
Hydrology and Water Assessment		
5.1	General	128
5.2	Hydrological analysis	128
5.2.1	Surface water availability	128

Para no.	Particulars	Page No.
5.2.2	Water requirement	129
5.2.3	Regeneration	130
5.2.4	Water Balance	130
5.2.5	Water balance at Indravati sub-basin	131
5.3	Hydrological and water balance studies of the Godavari basin between SRSP and Inchampalli barrage site	136
5.3.1	Computation of gross annual yields	136
5.3.2	Import and Export	139
5.3.3	Computation of various requirements	140
5.3.4	Water Balance	144
5.4	Hydrological and water balance studies of sub-basins lying enroute the link	145
5.4.1	Hydrological and water balance studies of Muneru sub-basin of Krishna basin	146
5.4.2	Hydrological and water balance studies of Palleru sub-basin of Krishna basin	151
5.4.3	Hydrological and water balance studies of Musi sub-basin of Krishna basin	155
5.5	Hydrological and water balance studies of the Krishna basin upto Nagarjunasagar dam site	159
5.6	Simulation studies at Inchampalli	163
5.6.1	Computation of inflows into Inchampalli	163
5.7	Demands from Inchampalli Pond	164
5.7.1	Demands of Inchampalli – Nagarjunasagar Link	164
5.7.2	Arrangement for diversion of water through Inchampalli – Nagarjunasagar link canal – its integration with SRSP stage II, SLBC etc.	165
5.7.2.1	Command area under Kakatiya canal stage–II of Sri Ram Sagar Project stage–II	165
5.7.2.2	Command area under Srisailam left bank canal	165
5.7.2.3	New area under Gottimukkala feeder	166
5.8	Results of Simulation	166
5.9.1	Floods and drainage	167
5.9.2	River geometry	167
5.10	Groundwater recharge	167
5.11	Navigation	169

Para no.	Particulars	Page No.
	Chapter - 6 Design Aspects	
6.1	General	170
6.2	Geology, seismicity and foundation	170
6.2.1	Geology	170
6.2.2	Seismicity	170
6.2.3	Foundation treatment	171
6.3	Barrage at Inchampalli	171
6.3.1	Hydraulic design of barrage	171
6.4	Design of conveyance system	172
6.4.1	The lead canal	174
6.4.2	Description of the canal alignment	174
6.4.3	Description of the lead canal alignment	182
6.4.4	Gottimukkala feeder canal	183
6.4.5	Srisailam LBC feeder branch	184
6.4.6	Utilisation of water potential from the streams crossed by the link canal	184
6.4.7	Description of soil profile along the canal alignment	184
6.4.8	Evaluation of the design parameters based on samples collected enroute	185
6.4.9	Lining	185
6.4.10	Transmission losses	185
6.5.1	Design calculations for adequacy of canal section	185
6.5.2	Canal capacity	189
6.5.3	Design of canal	190
6.5.4	Tunnels	192
6.5.5	Lifting arrangements	195
6.5.6	Power house at offtake of link canal from Nagarjunasagar	198
6.5.7	Description of soil profile along the link canal	199
6.5.8	Evaluation of design parameters	199
6.5.9	Transmission losses	200
6.6	Canal structures	200
6.6.1	Cross drainage/cross masonry works/regulators	200
6.6.2	Layout and foundation	200
6.6.3	Cross drainage works	200
6.7	Cost curves for cross drainage and cross masonry works	203
6.8	Integration of link canal with existing reservoirs and canals	203
6.9	Canal automation and branch canals	204
6.10	Instrumentation	204
6.11	Other studies	204

Para no.	Particulars	Page No.
	Chapter - 7 Reservoirs & enroute storages	
7.0	General	205
7.1	Fixation of storage and reservoir levels	206
7.1.1	Headworks	206
7.1.2	Intermittent/balancing reservoirs	207
7.1.3	Tail end structure	210
7.2	Sedimentation	212
7.3	Life of reservoir	212
7.4	Effect of link project on life of reservoirs	213
7.4.1	Nagarjunasagar reservoir	213
7.4.2	Somasila reservoir	213
7.5	Capacities and sufficiency of balancing reservoirs	214
7.6	Area of submergence	216
7.6.1	Inchampalli barrage	216
7.6.2	Nagarjunasagar reservoir	216
7.6.3	Somasila reservoir	216
7.6.4	Grand Anicut	216
7.7	Evaporation losses	216
7.7.1	Nagarjunasagar reservoir	217
7.7.2	Somasila reservoir	217
7.7.3	Grand Anicut	217
7.8	Ecological releases	217
	Chapter - 8 Irrigation Planning and Command Area Development	
8.0	General	219
8.1	Existing /proposed irrigation facilities in the proposed project command area	219
8.2	Proposed command area under the link canal	221
8.2.1	New areas proposed enroute the link canal	221
8.2.2	Stabilisation of existing commands	229
8.2.3	Net increase in irrigation facilities due to the link project	232
8.3	Existing cropping pattern	232
8.3.1	Existing area under rainfed cultivation	232
8.3.2	Existing area under irrigation	233
8.3.3	Source wise irrigation	233
8.4	Soil surveys	233
8.4.1	Soil capability classification	233
8.4.2	Land irrigability classification	234
8.5	Agro climatic conditions	235
8.5.1	Rainfall	235
8.5.2	Temperature	235
8.5.3	Humidity	235

Para no.	Particulars	Page No.
8.5.4	Sunshine	235
8.5.5	Wind velocity	236
8.5.6	Evaporation	236
8.5.7	Cloud cover	236
8.5.8	Frost free days	236
8.6	Proposed cropping pattern	236
8.6.1	Approved cropping pattern	236
8.6.2	Cropping pattern adopted under the link project	237
8.6.3	Proposed irrigation facilities	237
8.6.4	Scope for double & multiple cropping pattern and change in cropping pattern	238
8.6.5	Attitude of farmers towards modern irrigated agricultural practices	238
8.7	Water planning	238
8.7.1	Irrigation water requirement	239
8.7.2	Domestic and industrial water supply	241
8.7.3	Transmission losses	242
8.7.4	Environmental releases	242
8.7.5	Evaporation losses	243
8.7.6	Total water demands of the link project	243
8.7.7	Designed head discharge of the link project	243
8.7.8	Groundwater	244
8.7.9	Conjunctive use/groundwater support	244
8.8	Command area drainage	244
8.9	Water courses/field channels	245
8.10	Water management	245
8.10.1	Proposals for participatory irrigation management including formation of water users association	246
8.10.2	Scope of introduction of modern technologies viz. sprinklers,drip irrigation etc.	246
8.10.3	Existing practice of department of agriculture for popularising micro irrigation	247
8.10.4	Facilities for training	247
8.10.5	Existing extension activity and proposals for its improvement	247
8.11	Agricultural support services	247
8.11.1	Agricultural marketing	247
8.11.2	Development of horticulture	248
8.11.3	Organic farming	248
8.11.4	Minimum support price	248
8.11.5	Crop insurance	248
8.11.6	Agricultural credit	249
8.11.7	Use of improved seeds	249
8.12	Command area	249

Para no.	Particulars	Page No.
8.12.1	Location	249
8.12.2	Classification of land (Forest, Grass Land, Cultivable Land, Cultivable Waste, Barren Land)	250
8.12.3	Size of land holdings	250
8.12.4	Climate of command area	250
8.12.5	Irrigation	251
8.12.6	Socio-economic aspects	252
8.12.7	Infrastructure facilities	252
8.12.8	Topography & soils	253
8.12.9	Groundwater and drainage	254
8.12.10	Agriculture	254
8.12.11	Farmers' attitude towards improved agricultural practices	254
8.12.12	Identification of problems in enroute command area	255
8.12.13	Proposed Cropping Pattern with justification based on Land Irrigability Classification, Agro Climatic Conditions Developed, Irrigated Cropping Pattern in Adjoining Projects / Areas etc	256
8.12.14	Land development work proposals	256
8.12.15	Ayacut roads	257
8.12.16	Benefits	257
	Chapter - 9 Power	
9.1	General	259
9.2	Present status of power development	259
9.2.1	Telangana	259
9.2.2	Andhra Pradesh	266
9.2.3	Tamil Nadu	271
9.3	Power requirements	279
9.3.1	Power requirement of main link canal	279
9.4	Power potential of the link project	281
9.4.1	Power generation from canal head power house at Nagarjunasagar	281
9.4.2	Proposed canal power house at Musi reservoir	282
9.4.3	Solar power	283
9.5	Effect of Godavari (Inchamapalli) - Cauvery (Grand Anicut) link project on power scenario of southern States	283
	Chapter - 10 Construction program, manpower deployment and plant planning	
10.0	General	285
10.1	Objective of the project	285
10.2	Main Components of the Link proposal (DPR stage)	286

Para no.	Particulars	Page No.
10.3	Construction programme	287
10.4	Basis for Study	288
10.4.1	General	288
10.5	Construction material sources	289
10.6	Basic considerations	289
10.7	Scheduled working hours and shifts	289
10.7.1	Construction period	290
10.8	Construction Methodology and Equipment Planning	290
10.8.1	Proposed barrage	291
10.8.2	Canal Excavation	292
10.8.3	Tunnels	295
10.8.4	Lifts / power houses	296
10.8.5	Branch canals and command area	296
10.8.6	Proposed Construction Methods	297
10.9	Manpower Planning	299
10.9.1	Organisation setup	299
10.10	Year wise allocation of cost	300
	Chapter - 11 Environmental impact assessment and environmental management plan	
11.0	General	301
11.1	Proposed project	302
11.2	Project description	302
11.3	Project justification	303
11.3.1	Study area	304
11.4	Legal status of the project	305
11.5	Basic information	306
11.6	Environmental and ecological aspects of the storage reservoirs/ ponds	307
11.6.1	Impact of Inchampalli barrage	307
11.7	Impact of the link canal	310
11.7.1	Land acquisition for the link canal	310
11.7.2	Groundwater	311
11.7.3	Surface water	312
11.7.4	Flood control	312
11.7.5	Pollution and industrial development	312
11.7.6	Aquatic life	313
11.7.7	Public health	314
11.7.8	Water logging and salinity	315
11.7.9	Climate and ecology	315
11.7.10	Natural resources	315
11.8	Labour	315

Para no.	Particulars	Page No.
11.9	Sedimentation	316
11.10	Environmental status	316
11.10.1	Grounwater regime	316
11.10.2	Aquatic life	316
11.10.3	Tourism	317
11.10.4	Health hazards	317
11.11	Environmental impact	317
11.11.1	Surface water regime	317
11.11.2	Impact on groundwater	317
11.11.3	Aquatic life	318
11.11.4	Natural resources	318
11.11.5	Effect of water bodies	318
11.11.6	Aquatic weeds	318
11.11.7	Climatological changes	318
11.11.8	Impact on seismicity	319
11.12	Adverse impact of the link project	319
	Chapter - 12 Socio economic studies, Resettlement & Rehabilitation	
12.1	Introduction	320
12.2	Socio economic profile and survey	320
12.2.1	Regional profile from the available secondary data	321
12.2.2	Project specific aspects	325
12.2.3	Short term impact of the link project	334
12.2.4	Long term impact of the link project	334
12.3	Resettlement & rehabilitation	335
12.3.1	Resettlement & rehabilitation package	335
12.3.2	Project affected community	335
12.3.3	People's perception towards rehabilitation package	336
12.3.4	Measures for resettlement	336
12.4	Measures for rehabilitation	340
12.5	Local area development plan	340
12.6	Monitoring and evaluation	341
12.7	Beneficial economic impact	341
12.7.1	Beneficial impact of link canal	341
12.7.2	Employment generation during the construction of the project	342
	Chapter - 13 Cost estimates	
13.0	General	347
13.1	Classification of units	349
13.1.1	Unit-I Headworks	350
13.1.2	Unit-II Conveyance system	355
13.1.3	Unit-III Hydro power	361

Para no.	Particulars	Page No.
13.1.4	Unit-IV Lifting arrangements	364
13.1.5	Unit-V Onfarm development	367
	Chapter - 14 Revenues, Benefit Cost Ratio and IRR	
14.1	Yearly development programme from the date of starting construction of the link project	368
14.2	Sources of revenue	368
14.3	Direct benefits	369
14.3.1	Irrigation	369
14.3.2	Water charges (Irrigation service fees)	369
14.3.3	Domestic and industrial water supply	370
14.3.4	Power generation	371
14.3.5	Pisciculture	371
14.3.6	Animal husbandry	372
14.3.7	Canal bank plantations	372
14.3.8	Other benefits	372
14.4	Indirect benefits	372
14.5	Concession in water rates	374
14.6	Administrative charges for water supply and revenue collection	374
14.7	Redress of scarcity	374
14.8	Commencement of realisation of the revenue	374
14.9	Total income from various sources	374
14.10	Manpower for collection of revenue	375
14.11	Annual costs	375
14.12	Benefit-cost ratio	376
14.13	Internal rate of return	376
14.14	Benefit cost ratio for flood control component	376
14.15	Role of the link project in the overall development of the region	376
	Chapter - 15 Other aspects of the project	
15.0	General	378
15.1	Scope of the link project	378
15.2	Rights of beneficiary states	379
15.3	Sharing of water due to link proeject	379
15.4	CEIA studies	379
15.5	Solar power potential	379
15.6	Financial resources	380
15.7	Future utilisation of facilities created (buildings)	381
15.8	Role of the project in addressing the issues	381
15.9	Public cooperation and participation	381
15.10	Public awareness	382