Damanganga-Pinjal Link Project

Salient Features

Sl. No.	Particulars			
1	**Name of the Project**	Damanganga-Pinjal Link Project		
2	**Type of Project (Irrigation or Multipurpose)**	Drinking Water Supply		
3	**Location**	Maharashtra and Gujarat		
3.1	River Basin			
a)	Name	Damanganga basin and Pinjal Sub basin of Vaitarna basin		
b)	Located in			
i)	State(s)	Gujarat and Maharashtra		
ii)	Countries (if international river)	Not Applicable		
3.2	River / Tributary	Damanganga/Vagh; Vaitarna/Pinjal		
3.3	State(s)/District(s)/Taluka(s) in which the following are located:			
a)	Reservoirs	**Bhugad**	**Khargihill**	
	State	Gujarat and Maharashtra	Maharashtra	
	District	Valsad and Nasik	Nasik and Thane	
	Taluka	Kaprada and Trimbak	Trimbak, Jawhar and Mokhada	
b)	Head work	**Bhugad dam**	**Khargihill dam**	**Khargihill saddle dam**
	State	Gujarat and Maharashtra	Maharashtra	Maharashtra
	District	Valsad and Nasik	Thane	Thane
	Taluka	Kaprada and Trimbak	Jawhar	Jawhar
c)	Command Area	Not Applicable. The project has been planned as drinking water supply project to augment domestic water supply of Mumbai city		
d)	Power house	**Bhugad**	**Khargihill**	
	State	Maharashtra	Maharashtra	

	District	Nasik	Thane	
	Taluka	Trimbak	Jawhar	
3.4	Name of village near Head works	Bhugad	Behadpada	
3.5	Location of Head works	Bhugad dam	Khargihill dam	Khargihill saddle dam
a)	Longitude	20^0 12’ 30”	20^0 05’ 05”	20^0 05’ 18”
b)	Latitude	73^0 17’ 32”	73^0 16’ 27”	73^0 15’ 22”
c)	Lies in Earthquake Zone No.	The project sites lie in seismic Zone-III as per the zoning map of India (IS: 1893-2002, Part-1).		
3.6	Project area reference to:			
a)	Survey of India Topo-sheets	46 H/8 and 46 E/5		
b)	Index Plan	Plate: 1.1		
3.7	Access to the project	Name	Distance from project site	
a)	Airport	Mumbai/ Surat	170 km to 200 km	
b)	Rail head	Valsad/Umbergaon on WR	90 km to 100 km	
c)	Road head	Valsad/Bhilad on NH-8, Nasik on NH-3	80 km to 95 km	
d)	River port	Hazira	100 km to 150 km	
e)	Seaport	Mumbai	170 km to 200 km	
4	**Interstate aspects of the project**			
a)	Catchment area of the basin			
	Damanganga basin (km^2)	2331(km^2)		
	Vaitarna basin (km^2)	3647 (km^2)		
b)	State-wise details of catchment area	Damanganga Basin (km^2)	Vaitarna Basin (km^2)	
	Maharashtra	1438	3647	
	Gujarat	430	-	
	Union territory			
	i) Dadra & Nagar Haveli	393	-	
	ii) Daman & Diu	70	-	
	Total	2331	3647	
c)	Submergence due to projects (ha)	**Bhugad Dam**	**Khargihill Dam**	
	Maharashtra	916	1558	
	Gujarat	987		
	Total	1903	1558	
d)	Water allocation for the	Water sharing between the States of Gujarat		

	state (if any) / country	and Maharashtra is under finalisation							
e)	Water allocation for other states / countries	Not Applicable							
f)	Committed utilisation	**Bhugad (Mm^3)**				**Khargihill (Mm^3)**			
	Upstream Projects	Irriga-tion	Water supply	Indu-strial	Hydel	Irriga-tion	Water supply	Indu-strial	Hydel
i)	Projects completed	18.77	-	-	-	14.38	-	-	-
ii)	Projects under construction	16.69	-	-	-	29.65	-	-	-
iii)	Future projects	8.20	2.03	6.65	77.70	16.78	0.72	3.94	57.51
iv)	Any other	-	-	-	-	-	-	-	-
	Downstream Projects	**Bhugad (Mm^3)**				**Khargihill (Mm^3)**			
i)	Projects completed	91.00 (Madhuban dam)	-	-	-	-	-	-	-
ii)	Projects under construction	-	-	-	-	-	-	-	-
iii)	Future projects	11.00	5.00			9.00	5.00	-	-
iv)	Any other								
	Sub-total	91	7.03	6.65	77.70	69.81	5.72	3.94	57.51
g)	Proposed annual utilisation by the project								
i)	Irrigation	Not Applicable				Not Applicable			
ii)	Water supply to Mumbai city (Mm^3)	210				369			
iii)	Hydel (evaporation losses) (Mm^3)	-				-			
iv)	Thermal Power (Mm^3)	-				-			
v)	Local Domestic and Industrial (Mm^3)	5.00				5.00			
	Gross annual utilisation (Mm^3) (sum of i to v)	215				374			
h)	Minimum agreed / proposed flow in the river for maintaining ecology	5.79				5.11			
5	**Estimated life of the projects (years)**	100 years							
6	**Irrigation (ha)**	Not Applicable. Damanganga – Pinjal link has been planned as a drinking water supply project to augment domestic water requirement of Mumbai city.							
7	**Flood control**	No flood control envisaged							

8	**Navigation**	No navigation proposed			
9	**Water supply**				
9.1	Domestic				
a)	Names of towns / villages served	Damanganga – Pinjal Link Project will augment domestic water supply of Mumbai city. The population of Mumbai city as per census of the year 2011 is 1.84 crores. In addition, the villages lying in the periphery/vicinity of the reservoirs and villages developed for settlement of PAPs will also get drinking water supply to an extent of 10 Mm^3(for both Domestic and Industrial use) from these two reservoirs.			
b)	Size of population served				
c)	Quantum of water made available (m^3)	895 Mm^3 (210 Mm^3 from Bhugad dam; 369 Mm^3 from Khargihill dam; and 316 Mm^3 from Pinjal dam)			
d)	Quantum of water per capita (litre)	Diverted water will be used to augmentation of domestic water supply of Mumbai city			
9.2	Industrial				
a)	Name(s) and its location(s)	The project envisages providing 10.0 Mm^3 of water to meet the water requirements of the population in the vicinity of the reservoir for various uses including industrial purpose.			
b)	Quantum of water made available (m^3)				
10	**Project performance**	**Bhugad**		**Khargihill**	
		Period of simulation	**No. of failure**	**Period of simulation**	**No. of failure**
a)	Irrigation	Not Applicable		Not Applicable	
b)	Power	30	-	30	-
c)	Flood control	Not Applicable		Not Applicable	
d)	Water supply	30	-	30	-
e)	Navigation	Not Applicable		Not Applicable	
11	**Hydrology**				
11.1	Catchments				
11.1.1	Catchments area at headwork site	**Bhugad Dam** (km^2)		**Khargihill Dam** (km^2)	
a)	Gross	708		646	
b)	Intercepted				
i)	By existing projects	52		20	
ii)	By ongoing projects	33		19	
iii)	By contemplated projects	75		154	
c)	Un-intercepted	548		453	
11.1.2	Catchment area classification according	**Bhugad Dam**		**Khargihill Dam**	

	to mode of precipitation				
a)	Rain-fed (km^2)	708		646	
b)	Snow-fed (km^2)	Nil		Nil	
11.2	Precipitation				
11.2.1	Catchments	**Annual rainfall (mm)**		**Annual Snowfall (mm)**	
		Damanganga	**Pinjal**	**Damanganga**	**Pinjal**
a)	Average	2245	2758	Nil	Nil
b)	Maximum	2983	2983	Nil	Nil
c)	Minimum	1657	2440	Nil	Nil
11.2.2	Command Area	Not Applicable			
11.3	Annual yield calculated at the proposed site (Mm^3)	**Bhugad**		**Khargihill**	
		Gross	**Net**	**Gross**	**Net**
a)	Average yield	785.1	667.7	985.8	871.3
b)	At 50% dependability	733.2	610.1	939.4	820.2
c)	At 75% dependability	517.3	394.6	748.0	629.4
d)	At 100% dependability	372.4	283.7	477.0	400.9
11.4	Climatic Data (command)	Not Applicable			
11.5	Seismic coefficients	**Bhugad Dam**		**Khargihill Dam**	
		Concrete	Earthen	Concrete	Earthen
a)	Horizontal	0.09	0.02	0.18	0.04
b)	Vertical	0.09	0.02	0.17	0.03
11.6	Utilisation within the State (Mm^3)	Water sharing between the States of Gujarat and Maharashtra is under finalisation			
11.6.1	Water availability (State's share in case of interstate river)				
11.6.2	Committed utilisation	**Bhugad dam** (Mm^3)		**Khargihill Dam** (Mm^3)	
		Major & Medium	Minor	Major & Medium	Minor
a)	Upstream Projects				
i)	Projects completed	-	18.77	-	14.38
ii)	Projects under construction	-	16.69	-	29.65
iii)	Future projects	-	94.58	-	78.95
iv)	Any other	-	-	-	-
b)	Downstream Projects				
i)	Projects completed	91	-	-	-
ii)	Projects under construction	-	-	-	-

iii)	Future projects	-	-	-	-
iv)	Any other	-	-	-	-
11.6.3	Proposed utilisation by the project	**Bhugad Dam**		**Khargihill Dam**	
a)	Irrigation	Not Applicable		Not Applicable	
b)	Water supply (Mm^3)	210		369 Mm^3	
11.7	Floods near the headwork site				
11.7.1	Observed period of record				
a)	Maximum water level (El-m)	110.03		88.30	
b)	Maximum discharge estimated (Cumec)	8700		1584	
c)	Year of occurrence, date	3rd August, 2004		13th , July, 1994	
11.7.2	Estimated Flood - Magnitude (Cumec)	**Bhugad Dam**		**Khargihill Dam**	
a)	50 year return period diversion flood (Cumec)	3786		4138	
b)	100 year return period diversion flood (Cumec)	4074		4418	
c)	Standard project flood	Not Applicable		Not Applicable	
d)	Maximum probable flood (Cumec)	8992		10222	
11.7.3	Design flood (Cumec)				
a)	Dam (Cumec)	8992		10222	
b)	Weir / Barrage	Not Applicable		Not Applicable	
c)	Construction Diversion	Not Applicable		Not Applicable	
d)	Flood control works	Not Applicable		Not Applicable	
11.7.4	River flows (minimum observed)	Damanganga		Vagh	
a)	Water level (El-m)	River bed level		River bed level	
b)	Discharge (Cumec)	0.00		0.00	
c)	Months of Nil flow, if any	January to May		January to May	
12	**Reservoir**	**Bhugad**		**Khargihill**	
12.1	Water levels (m)				
a)	Maximum Water Level (m)	164.249		155.000	
b)	Full Reservoir Level (m)	163.870		154.520	
c)	Minimum Draw Down Level (m)	124.830		109.750	
d)	Outlet levels				

i)	Irrigation (m)	Not Applicable		Not Applicable	
ii)	Power (m)	120.00		105.75	
iii)	Others (please specify)	Nil		Nil	
e)	Dead Storage Level (m)	112.50		93.00	
12.2	Free board (m)	4.07		5.04	
12.3	Wave height (m)	2.76		2.13	
12.4	Live storage (Mm^3)	398.574		420.046	
12.5	Capacity at (Mm^3)				
a)	Full reservoir level (Mm^3)	427.07		460.896	
b)	Minimum draw down level (Mm^3)	28.496		40.850	
c)	Dead storage level (Mm^3)	5.280		2.542	
12.6	Flood absorption capacity (Mm^3)	Not Applicable			
12.7	Sedimentation (Mm^3) and levels after	**Bhugad Reservoir**		**Khargihill Reservoir**	
	Years	50 Years	100 Year	50 Year	100 Year
a)	Above MDDL	26.29	52.54	24.03	48.55
b)	Below MDDL	10.60	21.60	10.20	19.20
c)	Encroachment of live storage (per cent)	6.6 %	13.2 %	5.7 %	11.6 %
a)	Sedimentation volume (Mm^3)	36.79	73.46	33.92	67.73
b)	New zero elevation	107.80	112.50	89.60	93.00

12.8	Average monthly evaporation losses from the reservoir	Monthly Evaporation depths (mm)	
		Bhugad and Khargihill Reservoirs	Pinjal Reservoir
	Jan	127.6	142.6
	Feb	127.6	66.0
	Mar	203.2	55.8
	Apr	225.6	75.0
	May	251.6	105.4
	Jun	203.2	105.0
	Jul	101.6	99.2
	Aug	101.6	114.7
	Sept	152.4	150.0
	Oct	203.2	207.7
	Nov	152.9	225.0
	Dec	127.6	235.6

12.9	Seepage in the reservoir	Both the reservoirs are appeared to be tight	
13	**Submergence**		
13.1	Land and property submerged	**Bhugad Reservoir**	**Khargihill Reservoir**
a)	Villages affected (No.)	14	16
i)	Fully	Nil	Nil
ii)	Partially	14	16
b)	Land affected (ha)		
i)	Gross	1903	1558
ii)	Culturable	810	612
iii)	Forest	290	676
iv)	Others (specify)	803	270
c)	Buildings / houses (No.)	523	452
d)	Road / Rail (km)	Nil	Nil
e)	Transmission lines (km)	Nil	Nil
f)	Any other	Nil	Nil
13.2	Submergence ratio (with reference to CCA)	Not Applicable	
13.3	Number of families affected	**Bhugad**	**Khargihill**
		1098	1204
13.4	Anticipated back water levels at important places along the periphery of reservoir	**Bhugad Reservoir**	**Khargihill Reservoir**
		164.249 m upto 15 km from dam axis	155.000 m upto 16 km from dam axis
14	**Head works**		
14.1	Dam		
14.1.1	Embankment Dam	**Bhugad**	**Khargihill**
a)	Type of dam (Homogenous/Zoned/Rock-fill/Concrete faced)	Concrete faced Rock Fill (CFRD)	Concrete faced Rock Fill (CFRD)
b)	Length of dam at top (m)	527.5	341.0
i)	Right Flank	-	-
ii)	Left Flank (m)	527.50	341.0
c)	Top width (m)	16	10
d)	Maximum height above GL (m)	68.63	72.92
e)	Dyke(s)	-	Khargihill Saddle dam
i)	Number	-	1
ii)	Total length (m)	-	400.40
iii)	Maximum height (m)	-	25.92

f)	Type of cut off and maximum depth	Not Applicable	Not Applicable
14.1.2	Masonry and Concrete Dam (Non-over flow section)	**Bhugad Dam**	**Khargihill Dam**
a)	Type of Dam (masonry/concrete/ composite, any other)	concrete	concrete
b)	EL of top (m) (Road EL)	168.270	158.920
c)	EL of deepest foundation (m)	98.850	81.000
d)	Length at top (m)	174.5	173.20
e)	Length at the river bed (m)	174.5	173.20
f)	Width at top (m)	8.00	8.00
g)	Width at deepest bed level (m)	69.642	85.60
h)	Maximum height above deepest foundation level (m)	69.42	77.92
14.1.3	Spillway (overflow section)		
a)	Type of spillway (Ogee / chute / side channel / tunnel / siphon / any other type (specify)	Ogee	Ogee
b)	Full reservoir level (m)	163.870	154.520
c)	Maximum water level (m)	164.249	155.006
d)	Length (m)	149.50	104.00
e)	Maximum height above the deepest foundation (m)	54.15	63.52
f)	Crest level (m)	153.00	138.52
g)	Number of gates	9	6
h)	Type of gate	Radial	Radial
i)	Size of gate (mXm)	13.50x11.51	14.00 x 16.00
j)	Maximum discharging capacity (cumec) at	8849	9238
k)	Tail water level (m)		
i)	Maximum (m)	115 m	96.00 m
ii)	Minimum (m)	98.37 m	78.80 m
l)	Type of energy dissipation arrangement	Ski jump bucket type (Stilling basin	Ski jump bucket type (Stilling basin with

		with Chute block and end sill)	Chute block and end sill)
m)	Type of hoisting arrangement and its capacity	Hydraulic, 110 t	Hydraulic, 200 t
14.1.4	River sluice(s), Irrigation / Power outlet(s)		
a)	Purpose	River sluice	River sluice
b)	Number	2	3
c)	Size (m)	2.50 m x 3.0 m	3.00 m x 5.00 m
d)	Sill level (El-m)	108.0 m	98.0 m
e)	Number of gates	2	3
f)	Type of gate	Vertical lift	Radial
g)	Size of gate (mXm)	2.50 m (W) x 3.0 m(H)	3.00(W) x 5.30(H)
h)	Type of hoisting arrangement and its capacity	Hydraulic, 300 t	Hydraulic, 120t/150t
14.2	Barrage	No barrage proposed	
14.3	Weir	No weir proposed	
14.4	Head Regulator(s)	No Head Regulator proposed	
15	**Canal System**	Not Applicable. The diversion of water is through tunnels only and no canal is proposed.	
16	**Cropping Pattern**	Not Applicable	
17	**Power**	**Bhugad Powerhouse**	**Khargihill Powerhouse**
17.1	Type – Conventional / Pumped storage	Conventional	Conventional
17.2	Installed capacity (MW)	2.00	3.00
17.3	Annual PLF %	76.68	61.64
17.4	Annual energy (MU)		
a)	Firm (MU)	9.09	16.20
b)	Seasonal (secondary) (MU)	13.68	20.52
	Total (MU)	22.77	36.72
17.5	Off peak requirement for pumping*****	Not Applicable	Not Applicable
	***** For pumped storage projects only		
17.6	Head Race Channel / Tunnel	Not Applicable	Not Applicable
17.7	Balancing Reservoir	No balancing reservoir proposed	

17.8	Fore bay	No fore way proposed	
17.9	Intakes	Bhugad Powerhouse	Khargihill Powerhouse
a)	Upper Intake		
i)	Type & size of intake	Bell Mouth	Bell Mouth
iii)	Stability of the slope/cuts around intake	Not Applicable	Not Applicable
iv)	Submergence of the entry below water level	Yes	Yes
vi)	Intake gates-number, type & size	2 Nos.	2 Nos.
vii)	Details of anti-vortex arrangements	Centre line of Penstock is kept 4.83 m below MDDL	Centre line of Penstock is kept 4.0 m below MDDL
viii)	Type of hoisting arrangement and its capacity	Rope drum hoist, 25t/ 10 t capacity	Rope drum hoist, 25t/ 10 t capacity
b)	Lower Intake (for pumped storage scheme)	Not Applicable	Not Applicable
17.10	Surge tank / shaft	Not Applicable	Not Applicable
17.11	Penstocks / pressure shafts		
a)	Number, diameter & length	Diameter - 1.5 m Length - 177 m	Diameter - 1.5 m Length - 215 m
b)	Inclination	Not Applicable	Not Applicable
c)	Liner type		
d)	Grade of steel		
e)	Reach-wise rock cover		
f)	Reach-wise rock properties-RMR/Q		
g)	Reach-wise rock participation factors-computed & adopted		
h)	Reach-wise liner thickness		
i)	Necessity for heart treatment, if any		
j)	Bifurcation / trifurcation	one bifurcation	one bifurcation
17.12	Power House	**Bhugad Dam Power house**	**Khargihill Dam Power house**
a)	Type (surface or underground)	Surface	Surface
b)	Orientation	Not Applicable	Not Applicable

c)	Rock types encountered-RMR/Q values		
d)	Major wedge formations, if any		
e)	Rock ledge dimension between cavities		
f)	Maximum head (m)	54.87	64.52
g)	Minimum head (m)	15.83	19.75
h)	Head loss in water conductor system (m)	0.20	0.02
i)	Design head (m)	41.66	49.40
j)	Dimensions (m X m)	32.7 X 8.28	32.7 X 8.28
k)	Unit capacity	2 X 1.0 MW	2 X 1.5 MW
l)	Installed capacity (MW)	2.0 MW	3.0MW
m)	Type of turbine	Horizontal Francis	Horizontal Francis
n)	Type of generator	AC Synchronous	AC Synchronous
o)	Type of power house crane	EOT	EOT
p)	Number & size of draft tube gates/bulk head & capacity of hoists	2 Gates of 3.4 m X 2.34 m, Rope drum hoist of 6 t capacity	2 Gates of 3.4 m X 2.0 m, Rope drum hoist of 6 t capacity
17.13	Switch yard		
a)	Type	Out door	Out door
b)	Voltage level	33kV	33kV
17.14	Transformer Cavern	Not Applicable	Not Applicable
17.15	Tail Race Channel		
a)	Shape & size	Open channel of 12.7 m width	Open channel of 12.7 m width
b)	Length	70.0 m	60.0 m
c)	Recovery slope	1V:6H	1V:6H
d)	Maximum tail water level (m)	115.00	96.00
e)	Minimum tail water level (El-m)	107.50	89.00
f)	Average tail water level (El-m)	109.00	90.00
g)	HFL of recipient river channel at outfall	112.20	98.00
h)	Draft tube gates-number, type & size	2 number stop log type	2 number stop log type
17.16	Tail Race Tunnel	Not Applicable	Not Applicable
18	**Cost**		
18.1	**Cost of project (` lakh)**		

	Unit-wise			
	Unit – I: Head Works	271130 lakh		
	Unit – III: Power house	3531		
18.2	**Allocated cost (` lakh)**	Not Applicable. The project has been planned as drinking water supply scheme for augmenting domestic water supply of Mumbai city. As such whole cost of entire Project has been allocated to domestic water supply.		
a)	Irrigation	Not Applicable		
b)	Power	Not Applicable		
c)	Flood control	Not Applicable		
d)	Navigation	Not Applicable		
e)	Water supply	274661 lakh		
f)	Any other	-		
19	**Benefits / Revenue**			
19.1	Benefits	**Quantity**	**Unit Price**	**Value (Rs. in lakh)**
a)	Food production (tonne)	Nil	Nil	Nil
b)	Power (kwh)	25.29 MU	2.72/kWh	688
c)	Flood protection (ha)	Nil	Nil	Nil
d)	Navigation (tonnage)	Nil	Nil	Nil
e)	Water supply	579 Mm^3		72533
f)	Any other (fisheries)	Nil	Nil	Nil
20.2	Revenue	**Quantity**	**Rate**	**Amount (Rs. in lakh)**
a)	Betterment levy	Not Applicable		
b)	Water Rates	579 Mm^3		72533
c)	Irrigation Cess	Not Applicable		
d)	Pisciculture rights auction	Not Applicable		
e)	Power Rates	25.29 MU	2.72/kWh	688
f)	Navigation	Not Applicable		
i)	Cargo Rates	Not Applicable		
ii)	Regd. Charges	Not Applicable		
iii)	Passenger Tax	Not Applicable		
g)	Others	Not Applicable		
	Total			73221
21	Benefit Cost (BC) Ratio			
a)	BC Ratio	1.95		
b)	Internal Rate of Return (IRR)	16.29 %		