

CHAPTER 1: INTRODUCTION

1.1 GENERAL

The Narmada river is the fifth largest river in India and the largest west flowing river of Indian peninsula. It is known as the life line of Madhya Pradesh and Gujarat. Originating from Amarkantak in District. Shahdol of Madhya Pradesh, it travels a distance of 1312 km, before meeting the Arabian sea in gulf of Cambay in Gujarat, out of which 1077 km is in the state of Madhya Pradesh covering the districts of Shahdol, Dhindori, Mandla, Jabalpur, Hoshangabad, Harda, Khandwa, Khargone, Barwani, Dhar and Jhabua. Narmada river is an inter-state river. Narmada Water Disputes Tribunal has assessed the utilizable flow of Narmada at 28 MAF (34,357 M.cum) at 75% dependability, out of which 18.25 MAF has been allocated for utilization in the state of Madhya Pradesh. In order to utilize their share of water, Govt. of Madhya Pradesh has proposed 29 major, 158 medium and about 3000 minor projects in Narmada basin.

Indira Sagar Project (ISP) is one of the 30 major projects proposed in Narmada Basin with the largest storage capacity in the country. The project is located near Punasa village in Khandwa District of Madhya Pradesh. It is a multipurpose River Valley Project for development of water resources of Narmada which envisages an annual irrigation potential of 1.69 lakh ha and generation of 1000 MW of hydropower. The project shall also ensure supply of 0.06 MAF (74M.cum) of drinking water to rural areas in Khandwa district. The regulated releases from this project shall help in providing 8.12 MAF (10015 M.cum) of water to Sardar Sarovar Project ex-Maheshwar project after generation of power at down stream projects viz. Omkareshwar Project and Maheshwar Project in Madhya Pradesh. The salient features of Indira Sagar Project are given in Annexure- I.

1.2 PROJECT FEATURES

The main components of the project are as follows

- (i) Construction of a concrete gravity dam, 653 m long with a slightly curved alignment in plan and 92 m high above the deepest foundation level. It has a centrally located spillway with 20 radial crest gates of size 20 m (width) x 17 m (height) to pass a design flood (PMF) of 83,534 cumec (29.47 lakh cusec).

The gross storage capacity of the reservoir is 12,220 M.cum (9.9 MAF) and live storage of 9,750 M.cum (7.9MAF). A saddle dam is also proposed on the right flank of the dam, which will also form a portion of the road between Narmada Nagar and Bhopal.

- (ii) Construction of a 1000 MW sub-surface powerhouse on the right flank of dam with eight Francis turbine units of 125 MW each.
- (iii) Construction of 400 KV open switchyard on the right bank of river Narmada.

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- (iv) River diversion arrangement comprising of upstream and downstream coffer dams and 390 m long diversion tunnel of 8 m dia on the left bank.
 - (v) Construction of a tunnel of 8.25 m dia & 3.677 km long, popularly known as "Punasa Tunnel", with appurtenant structures taking off from the reservoir, designed to carry a discharge of 185 cumec inclusive of 25 cumec for Punasa lift irrigation scheme. This is followed by a 248.65 km long gravity flow left bank main canal with a head discharge of 160 cumec to irrigate 1.23 lakh ha of CCA, comprising 19000 ha in Khandwa District, 68000 ha in Khargone District and 36000 ha. in Barwani District, with an irrigation intensity of 138%.
 - (vi) The Punasa lift irrigation scheme will irrigate additional 35,008 ha of CCA in the higher cultivated areas of Khandwa District. A canal head powerhouse with three units of 5 MW each has also been planned at control structure of ISP Main Canal.

PLATE-1 shows the index map of the Project and its command area. PLATE-2 shows the general layout of the Indira Sagar Project showing various components of the project.

1.3 REGULATED RELEASES TO SSP

In accordance with Clause-IX of Narmada Water Dispute Tribunal (NWDT) award "Final Orders and Decisions", an annual regulated flow of 8.12 MAF (10015 M.cum) shall be released to Sardar Sarovar Project (SSP), ex-Maheshwar Project. The operation of Indira Sagar Project shall be carried out in such a way to facilitate the regulation of Sardar Sarovar

1.4 SETTING UP OF NARMADA HYDRO ELECTRIC DEVELOPMENT CORPORATION (NHDC) FOR IMPLEMENTATION OF THE PROJECT

Initially the project was under Govt. sector and was being executed by Narmada Valley Development Authority. (Govt. of M.P.). Subsequently a Memorandum of Understanding (MOU) was signed between National Hydroelectric Power Corporation (NHPC) and Government of Madhya Pradesh (GOMP) on May 16, 2000 for harnessing the hydro electric potential of the Narmada basin by executing the Indira Sagar Project and Omkareshwar Project through Narmada Hydro-electric Development Corporation (NHDC) - a joint venture of NHPC and Govt. of MP. The detailed text of MOU is enclosed at **Annexure -II**. As per this MOU, Unit-I (Dam) and Unit-III (Power House) have been transferred to NHDC.

- ☆ According to the MOU, the joint venture NHDC registered under the Companies Act 1956 has been set up to complete and manage the Dam (Unit-I) and the Power House (Unit-III) of the Indira Sagar Project and Omkareshwar Project. The NHPC would have the major share i.e. not less than 51% of the share holding in the joint venture. The equity contribution by GOMP to the joint venture is the expenditure incurred by GOMP before transferring these projects to NHDC on Dam (Unit-I) and Power House (Unit-III) of the Indira Sagar Project and Omkareshwar Project.
- ☆ The joint venture would comply with the provisions of Narmada Water Disputes Tribunal Award and the directions of Narmada Control Authority, (NCA), its various Sub-groups and Review Committee of the Narmada Control Authority (RCNCA), according to the MOU.

The works under Unit-I (Dam) and Unit-III (Power House) of Indira Sagar project were taken over by NHDC in October 2000 and various activities on the project are in full swing.

- 1.4.1** The works Unit-II (Canal) is being executed by NVDA that would bear the cost of canal network i.e. Unit-II. In addition the irrigation component cost of Unit-I i.e. 16.75% of cost of dam after the share of SSP in dam cost would also be borne by NVDA.

1.5 PROJECT COST

The Planning Commission has accorded investment clearance to the project for a cost of Rs.1,993.67 crores at 1988 price level. The Govt. of Madhya Pradesh have further given revised administrative approval to the project for Rs.2,167.67 crores, comprising of Rs.832.32 crores for Unit-I (Dam), Rs. 619.37 crores for Unit-III (Power House), Rs.541.98 crores for Unit-II (Canal), and Rs. 174 crores as cost of command area development and catchment area treatment.

After taking over of Unit-I & Unit-III of ISP by the NHDC, the project estimate has been further revised. Cabinet Committee on Economic Affairs, Govt. of India in March, 2002, accorded approval to the cost estimate of Rs.4,355.57 crore (including IDC of Rs.488.37 crore) at September, 2000 price level for Unit-I and Unit-III. As per NWDT Award, 17.63% of the expenditure on account of Narmada Sagar Dam (Indira Sagar Dam) is chargeable to Sardar Sarovar Project in lieu of regulated supplies to be made from Indira Sagar Project.

The tentative cost estimate of Rs.1,200 crore at September, 2000 price level has been projected by NVDA for Unit-II (Canal) works. The revised cost estimate of Unit-II (Canal) is yet to be approved by the Planning Commission.

1.6 SCOPE OF THE PRESENT STATUS REPORT

The present report contains physical and financial progress of various components of Indira Sagar Project (ISP) for the period ending March, 2005 vis-à-vis the implementation schedule and also highlights the problems faced during the implementation and actions taken by the planners/project authorities to overcome the problem. This report is based on the field visits under taken by the officers of Narmada Control Authority and the progress reports received from NHDC and NVDA till the reporting period.

CHAPTER 2: DAM COMPLEX

2.1 GENERAL

The main dam is a concrete gravity dam, 92.0 m high and 653.0 m long along its curved axis. It comprises of 35 blocks, of which blocks no. 4 (part) to 16 (part) constitute the main spillway and blocks no. 16 (part) to 24 (part), the auxiliary spillway. Blocks no. 1 to 4 (part) and blocks no. 24 (part) to 35 form the non-over flow portion of the dam.

During the reporting period i.e. March '05 to September '05, the casting of spillway Deck Bridge were completed. The erection of balance 3 spillway radial gates were completed during the period all the spillway radial gates were made operational by September, 2005.

The progress of works is as given in the following paragraphs.

2.2 MAIN DAM (ICB Package- I)

2.2.1 SPILLWAY PORTION

During the period ending September, 2005, the balance 3 radial gates of spillways have been erected and Concrete placement for the cardenic suspension system and for rail track over spillway was done. Deck slab for 8 spans of Auxiliary spillway (i.e. block 16 to 24) and 12 span were completed in all respect

As reported in previous report, the divide wall work has also been completed up to the level of 220.50 m., i.e. the final level. The roller buckets for the main spillway and auxiliary spillway have been completed in all respect.

As regards the performance of the slotted roller bucket of ISP spillway after construction of the Omkareshwar project, NCA has referred the matter to NVDA to take up the combined model studies for Indira Sagar Project and Omkareshwar Project to study the effect of Omkareshwar reservoir on the functioning of roller bucket of ISP. NVDA needs to expedite the model studies in association with NHDC.

Cumulative Progress of works on Dam as of 31.09.2005 are as follows:

Name of items	Total estimated quantity	Cumulative progress up to 31.03.05	Cumulative progress up to 31.09.05
1.Excavation	7.13 lakh cum	Completed	Completed
2.Concerting	13.92 lakh cum	13.915 lakh cum	13.9171 lakh cum

2.2.2 TRAINING WALL & DOWN STREAM PROTECTION WORKS

The works of left training wall and right training wall have been completed up to the final level of 244.0 m. The downstream protection works along with the treatment of shear zone is also complete.

2.3 RIVER DIVERSION WORKS

Installation of gates of Diversion Tunnel (DT) and Goose Neck Tunnel (GNT), the service gate, emergency gates and the hydraulic hoists arrangement are complete. Emergency gate for the diversion tunnel has also been installed to facilitate reservoir filling. The concrete plugging of DT has been completed.

2.4 RADIAL CREST GATES FOR SPILLWAY

Contract for Design, supply, erection and testing of 20 Nos. radial crest gates of size 20 m (wide) x 17 m (high) with hydraulic hoist have been awarded to M/s Technopromexport, Russia at an accepted tender cost of Rs.100 crores. The status of works of radial gates as on 31.09.05 are as follows:

The fabrications of 2 nos. stop logs have been completed. Erection and Concreting of sill beams of stop logs and vertical grooves in piers for stop logs in all the 20 bays have been completed.

Fabrication of all the 20 nos. radial crest gates has been completed. Erection and commissioning of sill beams of all the 20 radial gates have been completed. The work of erection of radial crest gates was in progress and by the end of the reporting period the erection of all 20 gates is over. Erection of power pack and hydraulic pipeline have been completed in all the gates.

All the gates were operated and tested with hydraulic power pack. Some minor works and testing and commissioning of gates at Full Reservoir Level (FRL) is balance to be done. The gates were operated to maintain the reservoir level within 255.0 m. as per the orders of Hon'ble High Court of M.P.

2.5 DIVERSION TUNNEL & GOOSE NECK TUNNEL GATE

The works of supply, erection, testing and commissioning of Diversion Tunnel & Goose Neck Tunnel Gates have already been completed. The 80 T Crane has been commissioned. Diversion Tunnel & GNT service gates have also been erected, commissioned and made operational.

2.6 DIVERSION WORKS OF STATE HIGHWAY No. 15.

Construction of all the four major bridges on state highway diversion work have been completed. Balance road works have been transferred to Madhya Pradesh Road Development Corporation (MPRDC) for further execution.

2.7 RAILWAY DIVERSION

57 Km long alternative railway track in lieu of 23.17 Km long Mumbai-Howrah line coming under submergence have been completed in all respect. The traffic was directed on newly constructed railway track on 19.05.2004.

2.8 SAINT SINGAJI SAMADHI STHAL

The works were awarded to M/s Balaji Boerwell on 29.04.2004 at a contract value of Rs. 3.43 crores. Almost all the works at the Samadhi sthal has been completed.

CHAPTER 3: POWER HOUSE COMPLEX

3.1 GENERAL

The Power House Complex of Indira Sagar Project has 8 units of 125 MW each in a sub surface power house. The water to the power house is fed through a 530 m long Head Race Channel (HRC). The Tail Race Channel (TRC) of 850 m length discharges water back to the river.

The progress of work in different packages are as follows:

3.2 CONSTRUCTION OF HEAD RACE CHANNEL FROM R.D 0 TO 420 M (ICB Package-II)

The entire work under this package has already been completed in March, 1998.

3.3 CONSTRUCTION OF HRC FROM RD 420M TO 530M, INTAKE STRUCTURE, PRESSURE SHAFT AND POWER HOUSE (ICB Package-III)

The work under this package was awarded to M/s J.P Associates, New Delhi in May, 1992 at the accepted tender cost of Rs.165.32 Crores to be completed in a period of nine years i.e. by May 4, 2001. The completion has been rescheduled to December, 2004. The progress of different components under this package is as follows:

3.3.1 HRC from RD 420 M to 530 M

The entire work of Head Race Channel in the reach RD 420 M to 530 M has already been completed.

3.3.2 Intake Structure

The works on 208 m long intake, situated after the head race channel have also been completed and the intake is operational.

3.3.3 Pressure Shafts

The works related to make up pieces and finishing the pressure shaft works in all units was completed in September 2004.

3.3.4 Power House: Civil & Structural works

As of September, 2005, excavation of pits and concrete placement for all the eight TG units have been completed. Present status of works is as under :

Sl. No.	Name of Work	Estimated Qty (Sept-2000)	Progress as on March, 2005	Progress as on September,2005
1	Excavation	15.27 Lakh cum	15.27 Lakh cum	15.27 Lakh cum
2	Concrete placement	3.48368 Lakh cum	3.56484 Lakh cum	3.56578 Lakh cum
3	Reinforcement	27500 MT (Revised)	27884.26 MT	27884.26 MT

The work of second stage concrete has been completed up to Generator floor level i.e. up to RL 201.00m from unit 1 to units 8 thus, erection of draft tube liners, lowering of draft tube cones, laying of cooling water pipe lines, stay rings, and spiral casing for all the eight units have been completed.

The roof has also been casted for whole power house. Thus at present all the major concreting work have been completed. The finishing and architectural works of Unit no. 5 to 8 are in progress.

3.4 SUPPLY & COMMISSIONING OF T.G.SETS

The contract for fabrication and supply of eight TG sets of 125 MW, each was awarded on August 29, 1997 to M/s Bharat Heavy Electricals Limited (BHEL) at the tender cost of Rs. 305.00 crores. Model tests on turbines were performed as per stipulations of the tender agreement and international practices in vogue. As reported earlier first stage embedded parts, draft tube liners and top and bottom draft tube cone for all the eight units have been supplied. In addition, foundation rings (8 No.), cavitation rings (8 No.) spiral casings (8 sets), and turbine shafts (8 No.) have also been supplied.

The work of erection of TG equipments/components has been awarded to M/s U.B. Engineering Ltd., Pune at the tendered cost of Rs. 11.63 crores.

As reported in the previous report all the eight Units of 125 MW each of ISP were commissioned by March 2005 and during the reporting period the Units were in commercial operation..

Status of progress of all the eight units of Power House as of 30th September, 2005 is summarized as follows :

Unit No.	Status of progress	Status of Power generation
Unit # 1	Synchronized with grid on 01.01.2004	Commercial generation started from 14.01.04.
Unit # 2	Synchronized with grid on 12.01.2004	Commercial generation started from 18.01.04.
Unit # 3	Synchronized with grid on 27.02.04	Commercial generation started from 06.03.04.
Unit # 4	Synchronized with grid on 28.03.04	Commercial generation started from 29.03.04.
Unit # 5	Synchronized with grid on 23.07.04	Commercial generation started from 27.07.04
Unit # 6	Synchronized with grid on 27.12.04	Commercial generation started from 07.01.2005
Unit # 7	Synchronized with grid on 27.10.04	Commercial generation started from 01.11.2004
Unit # 8	Synchronized with grid on 23.3.2005	Commercial generation started from 30.3.2005

3.5 TAIL RACE CHANNEL AND TAIL POOL (ICB PACKAGE -IV)

As mentioned in the earlier status reports, the work of Tail Race Channel (TRC) including shotcrete have already been completed.

3.6 400 KV SWITCH-YARD

All the works of erection of towers and girders, equipment foundations & earthing, cable laying, erection of control & relay panels, stringing, ACDB/DCDB system etc. for 8 bays and transfer bus of 400 kV Switchyard have been completed by M/s CGL Chennai in all respects. 8 bays of Switchyard have been commissioned. The switchyard Control Room building work which was awarded to M/s Tacon Infrastructure Ltd. Porbandar has also been completed.

3.7 POWER EVACUATION SYSTEM

The Loop-in-Loop-out Line (LILO) has been synchronized and commissioned successfully by MPSEB. The work of 400 kV AC Transmission Line (Main Line) was being executed by M/s. PGCIL on deposit work basis. The works of erection of all 223 towers including stringing of conductors have been completed. The line has been charged on 29.11.2004 by PGCIL.

3.8 GENERATOR TRANSFORMERS

The work of Design, Transportation, Supply, Erection, Testing and commissioning of Generator Transformers was awarded to M/s ABO Vadodara. As reported in earlier report the commissioning of all the units have already been completed.

3.9 12KV BUS DUCT

Design Transportation supply, Erection and Testing & Commissioning work of bus duct was awarded to M/s Power Gear Bangalore. The works have been completed and the 12 KV bus ducts commissioned in all respect.

3.10 UAT, SST & SWITCHYARD TRANSFORMERS

All the eight Unit Auxiliary Transformer (UATs) and two Station Service Transformers (SSTs) have already been erected and commissioned. Two Switchyard Transformers (SYTs) have also been erected and commissioned.

3.11 FIRE FIGHTING SYSTEM

The works of Fire Fighting system are being executed by M/s Mehta & Associates, Ahmedabad. The Pre Commissioning testing of fire fighting system has been carried out during the reporting period.

3.12 AIR CONDITIONING AND VENTILATION SYSTEM

The work of Air conditioning and ventilation system is being done by M/s Jindal Enterprises, New Delhi and erections of ducts have been completed in Switchyard and Power House Control room. The air conditioning and ventilation system have been made operational in Switchyard Control Room. Fixing and cabling work of 600 mm dia axial flow fans (exhaust fans) have been completed for all units. Installation of AC auxiliaries was in progress during the reporting period.

3.13 220 V DC SYSTEM

Two battery banks comprising of 110 No. Batteries along with DCDB and Battery Charger have been commissioned by M/s Caldye Automatics Ltd. Calcutta.

3.14 DG SETS

The civil works of DG set Building has already been completed. The DG set has also been erected and commissioned. The work was done by M/s Poweric, Mumbai.

3.15 ILLUMINATION SYSTEM

The works of illumination system is being executed by M/s Damodartech International, New Delhi. The conduit and wiring of switchyard control room building have been completed. Conduit and wiring have also been completed at EL 225 M & EL 220 M in Power House and it is in progress at EL 215 M & EL 195 M.

3.16 CABLES FOR POWER HOUSE

The work was being done by M/s ABB, Bangalore. The cable support and trays have been erected for all the eight units.

3.17 POWER HOUSE ELEVATOR

The erection and commissioning of Power House elevator has been completed by M/S OTIS, Mumbai and the elevator is operational.

3.18 11 KV SWITCHGEAR PANNELS

The 11 KV Switchgear Pannels were supplied by M/S System Contol Engineers, Salem. The work of erection and commission of panels is complete.

3.19 DRAINAGE & DEWATERING SYSTEM

All the 3 Nos. Dewatering pumps of 200HP each have been installed and commissioned. The 2 Nos. Drainage pumps of 120 HP capacity each have also been installed and commissioned.

3.20 HP & LP COMPRESSORS

Installation of one no. each of HP Compressor and LP Compressor have been completed.

3.21 HYDRO MECHANICAL WORKS

The status of the Hydro mechanical works in the power house area are as follows:

3.21.1 INTAKE GATES

All the intake gates have been commissioned

3.21.2 DRAFT TUBE GATES

All the gates have been lowered into the vent and 60 T Gantry crane for Draft Tube gates has been commissioned.

3.22 INTRIM POWER GENERATION FROM PROJECT

The target for power generation from April, 2005 to September, 2005 (reporting period) was fixed as 597.25 Million Units, however the power actually generated during the reporting period is 1115.70 Million Units. Thus power generation from the project up to 30th September 2005 is 2644.09 Million Units.

CHAPTER 4: PUNASA FACILITIES

4.1 INTRODUCTION

The component of water conveyance system connecting the Reservoir with the main canal of India Sagar Project to facilitate the withdrawal of water for irrigation requirements is commonly known as Punasa Facilities. This component, which is 9360 m long and takes off from the reservoir comprises of the works as detailed below:

- (i) A 3045 m long approach channel (from RD 0 m. to RD 3045 m.) and a 26 m. high control structure (at RD 3045 m.) for regulating the flows into the canal with 179.5 m. long Stilling Basin (RD 3045 m. to RD 3224.5 m.)
- (ii) A 8.25 m. diameter and 3677.25 m. long (RD 3232.75 m. to RD 6910 m.) tunnel known as "Punasa Tunnel" designed to carry a discharge of 185 Cumecs for irrigation including Punasa Lift Irrigation Scheme. Transition sections have been provided from RD 3224.5 m to RD 3232.75 m.
- (iii) A 2450 m. long exit channel after the Punasa tunnel (from RD 6910 m. to RD 9360 m.) to feed the water to main canal.

The status of construction of various components of Punasa facilities are as follows :-

4.2 APPROACH CHANNEL (RD 0.0 m to 2330 m)

As highlighted in the earlier report, the excavation for approach channel is already completed as on March 2003.

4.3 CONSTRUCTION OF APPROACHES ON EITHER SIDES OF THE PUNASA TUNNEL

The scope of work for the approaches on either sides of the Punasa Tunnel includes open excavation from RD 2330 m to RD 3232.75 m on the inlet side and from RD 6910m to RD 7160 m on the exit side. The work is being executed by M/s Asian Techs Limited, Cochin. The work was started in November, 1993 and was originally scheduled to be completed by June, 2000. Time extension was granted up to December, 2003. Estimated quantity of open excavation is 839.0 Th cum. Against this estimated quantity the excavation of 778.0 Th. Cum has been carried out and thus 100% progress has been achieved.

4.4 PUNASA TUNNEL

As highlighted in the earlier report, the tunnel work was originally scheduled to be completed by June, 2000 for which time extension was granted up to October, 2003. The work was completed during the extended period.

4.5 COMPOSITE CONTROL STRUCTURE CUM CANAL HEAD POWER HOUSE

The PRP (Project Review Panel) in its 10th meeting held on April 14, 1999 had advised to link the Punasa lift scheme with the composite control structure at R.D. 3045m. The revised scope of the project comprises a gated lift well, two nos. of irrigation sluices and a canal head power house with three units of 5 MW each (3x5 MW). The work of control structure (excluding canal head power house) was awarded to M/s Tacon Infrastructures Pvt. Ltd. Gujarat for an amount of Rs.12.32 crores in May, 2001. The scheduled date of completion was June,

2004. 100% progress achieved and work completed up to March 2005. The expenditure for Rs. 2105.53 lacs has been incurred on work.

4.6 BALANCE WORK OF SHOTCRETE IN APPROACHES OF TUNNEL

The shotcrete work on approaches was awarded to M/s National Guniting Bhopal for an amount of Rs. 35.86 lakhs in March 2005. The scheduled date of completion of this work is 31st July 2005. The work in all respect has completed by August 2005.

4.7 EXIT CHANNEL (RD 6910 m to RD 9360 m)

As reported earlier, the excavation in exit channel alongwith slope protection by shotcrete (RD 6910 m to RD 9360 m) has already been completed.

4.8 CANAL STRUCTURES

The structures namely super passage and super passage cum V.R.B. at R.D. 7290m and R.D. 8560m respectively on the exit channel was awarded to M/s National Guniting, Bhopal. The work has been completed March, 2005.

4.9 PUNASA LIFT SCHEME

The Punasa Lift Irrigation Scheme is proposed to irrigate 35,008 ha in the head reaches of canal in District Khandwa. The GoMP had accorded administrative approval to the survey estimates for Rs.14.50 lakh, in October 2001. On completion of survey & investigation the D.P.R. of Punasa LIS, was submitted to C.W.C. & Planning Commission by Government of M.P., N.V.D.D. vide Memo No. 2/16/27/02/2003/308 dated 10.03.2003. Advisory Committee of Planning Commission in its 84th meeting held on 12.05.2005 conditionally cleared the scheme.

The Govt. of M.P., NVDD Bhopal has accorded the administrative approval of Rs. 185.04 crore vide No. F-2/28/27/2/2005/2817

CHAPTER 5: Main Canal & Distributaries

5. GENERAL :

The main canal of Indira Sagar Project is 248.65 km long. The project envisages annual irrigation of 1.69 lakh Ha in a CCA of 1.23 Lakh Ha in 571 villages of Khandwa, Khargone and Barwani districts as per details given below.

S.No.	District	Irrigation in Lakh ha	No. of villages
1.	Khandwa	0.31	76
2.	Khargone	0.90	345
3.	Barwani	0.48	150
	Total	1.69	571

5.2 PHASING OF CANAL SYSTEM

The ultimate creation of potential from the project has been planned in three phases as tabulated below:

S.No.	Phase	Description of canal reach.	Irrigated Area (ha.) CCA	Revised construction period.
1.	I Phase	Main canal from km 0 to km 81 (inclusive of 16 distributaries)	36100	June 2006.
2.	II Phase	Main canal from km 81 to km 206	46800	June 2007
3.	III Phase	Main Canal from km 206 to km 248.65, including Khargone Lift Scheme	40100	June 2010
		Total	1,23,000	-

5.3 SURVEY AND ALIGNMENT:

Survey of the Main Canal km. 150.0 to R.D. 206 km is under progress. The alignment has been finalized upto km 150. The alignment of the distributaries namely, Gudariya, Bijapur, Kelwa, Julwania, Atud Kalmukhi, Sanawad, Lohari, Roopkhera, Delgaon, Baswa, Dhakalgaon, Nalwa, Neelkanth, Jhirwar Samurai, Khamkheda, Ratanpura, Borgaon, and Raipura have been finalized and approved.

5.4 STATUS OF PROGRESS OF THE MAIN CANAL: FIRST PHASE OF IRRIGATION

As per the revised implementation schedule of NVDA, the first phase of irrigation was envisaged to be completed by June 2004 completing main canal, distributaries, minors and sub-minors from km 0 to 81 km for irrigation 36100 ha. of land. As indicated above, alignment for a length of 150 km has been approved and technical sanction has been given for the works of the Main Canal from 0 to km 130.935 and works related to the land acquisition, inviting of tenders etc. have been taken up. In order to streamline the construction activity, the work of Main Canal from km 0 to 81 has been distributed in four reaches viz. km 0 to 20, km 20 to 41.25, km 41.25 to 58.856 and km 58.856 to 81.00 km considering each reach as a block for comprehensive development.

Reach wise progress of main canal is as follows:

5.5 CANAL REACH : km 0.0 to km 20.00

5.5.1 Survey & Alignment

As reported in earlier report that the survey & Alignment has already been completed.

5.5.2 Earthwork

The earth work of the main canal up to 20.00 km has already been completed.

5.5.3 Structures:

34 Nos. structures planned in this reach have been completed.

5.5.4 Lining

The work of paver lining of main canal has been completed in 19 km length in the reach between 0 to 20 km.

Detailed status of work on some major structures is furnished in the following table:

S. No.	Name of works	Date of Start	Scheduled date of Completion	Amount Revised (Rs. in lakhs)	Quantity (Th. Cum.)	Cumulative Upto Sept-05	% progress
1	2	3	4	5	6	7	8
1	ME-I: Structure Escape at R.D. 1000m	12.07.01	11.11.04	<u>249.17</u> 283.00	E/W 33 CC <u>10.201</u> 12.90	EW:33 CC:12.90	E/W 100% CC 100%
2	ME-II: Ajnal Aqueduct at RD 4350m	8.1198	31.03.05	520.00	EW:44.890 CC:23.50 25.0	EW:41 CC:24	E/W 100% C/C 100%
3	Ambak Aqueduct at RD 19191m.	23.6.01	30.12.04	358.40	E/W <u>86.75</u> 115.35 CC <u>12.04</u> 13.10	E/W 115.35 CC 12.89	E/W 100% C/C 100%

EW = Earth work , RCC = Reinforced Cement Concrete N=Original estimated quantity
D Revised quantity

5.5.5 Distributaries, Minors and Sub-Minors :

Altogether five distributaries are proposed between chainage km 0 to 20 to irrigate an area of 9169 ha. as per details given below:

S. No.	Name of distributaries & minors	Length (km)	Proposed Irrigated Area (Ha.)	Off taking Chainage on Main Canal (RD in km)
01	Gudariya	11.92	3097	1.750
02	Bijapur	03.72	610	5.900
03	Kelwa	10.51	4887	9.200
04	Phiparad	01.72	150	12.880
05	Julwaniya	3.0	425	17.00
	Total	30.87	9169	

Out of the five distributaries, earth work of Gudariya distributary has been completed. The construction of remaining four distributaries has been included in the scope of work for construction of paver lining work of main canal distributed into two reaches from km 0 to 7 and 7 to 17.00 alongwith its structures.

5.5.6 The survey for distributaries and its minor and sub-minor has been completed.

5.5.7 CANAL LINING WORK WITH CONSTRUCTION OF DISTRIBUTARIES, MINORS, SUB-MINORS AND W.B.M. ROAD ALONG CANAL

The construction of canal lining from km 0 to 7.0 with structures of Gudariya Distributary, minors, sub-minors and W.B.M. Road on canal bank of main canal is awarded to M/s. Gayatri Engineering, Hyderabad for Rs.2099.00 lakhs vide agreement No.01 of 03-04 dated 2.5.03. The work is in progress and 182.50 Th. Cum earth work and 30.60 Th.Cum of C.C. have been achieved. The expenditure for Rs.943.46 lakhs has been incurred on work. The work is scheduled for completion by June 2006.

The construction of canal lining from km 7 to 17 along with construction of Distributaries/Minors/Sub-minors and W.B.M. road on Main canal bank & 2 Nos. Head Regulator etc. is awarded to M/s. B.C. Biyani, Bhusawal, for Rs.2008.00 lakhs vide agreement No.01/03-04 dated 11.07.2003. The work is in progress and 277 Th. Cum earth work and 45.17 Th.Cum of C.C. have been achieved The work is scheduled for completion by 30 June 2006.

5.6 Canal Reach : km 20.0 – km 41.25

Status of activities in this reach is discussed in the following paras:

5.6.1 Survey and Alignment :

Survey and alignment of this reach has already been completed.

5.6.2 Earthwork

The work in the reach from km 20.00 to km 41.25 has been distributed in twelve groups. The details of the works related to 12 groups of Main canal in the reach are furnished in the following table:

PROGRESS OF WORKS UPTO SEPT-05: km 20 to km 41.25

Sr. No.	Name of works (Canal)	Award date/Date of start	Likely completion date	Received Tender Amount in Lakhs	Total Quantity in Th. Cum.	Progress		
						Upto Mar-05	Upto Sept-05	%
1.	ME-7 A : Earth work (24.729 km to 27.286 km) including 3 nos. structures	26.06.01	31.03.05	390.78	EW:397.70 CC : 4.170	EW 330.03 CC:4.17	EW: 385.76 CC : 4.17	EW:97% CC: comple ted
2.	ME-7 B : Earth work (27.286 km to 29.419 km) including 7 nos. structures	17.12.04	30.11.05	213.53	EW:47.11 CC : 6.930	EW: 38.99 CC : 4.36	EW : 43.81 CC : 5.33	EW:93% CC : 77%
3.	ME-8 B : Earth work (31.019 km to 31.284 km) including the super passage structures 31.284m	05.03.01	19.01.03	138.85	EW:139.00 CC : 1.284	EW:139 CC:1.168	EW : 139 CC : 1.284	EW:comple ted CC : 100%
4.	ME-9 B : Earth work (32.269 km to 33.168 km) including VRB structure 32487m	05.02.04	02.12.02	287.48	EW:290.58 362 CC : 0.692	EW:Completed CC: Completed	EW : 355.209 CC : 0.692	EW:comple ted CC: comple ted
5.	ME-9 C : Earth work (33.168 km to 35.90 km) ME-6B Earthwork with Bakur Aqueduct (23.0 to 24.608 km)	04.02.02	31.3.06	1263.20	EW: 702.668 CC : 30.512	EW:683.13 CC:28.156	EW: 683.13 CC : 28.156	EW:comple ted CC : 92%
6.	ME-9D : Earth work (35.980 km to 38.033 km) including 2 nos. structures.	30.04.01	29.10.02	263.05	EW: 290.528/ 303.703 CC : 1.043	EW: 303.703 CC:1.168	EW: 303.703 CC : 1.168 (Str.2 Nos)	EW: completed CC: comple ted
7.	ME-10A: Earth work (38.20 km to 39.04 km) including structures.	23.10.04	31.05.05	64.94	EW:46.64 CC:0.433	EW:40.11 CC 0.57	EW : 46.64 CC : 0.57	EW : 100% CC : 100% Work Completed
8.	ME-10B: Earth work (39.64 km to 40.807 km) including 3 nos. structures.	10.12.04	30.06.05	111.00	EW:27.33 CC:2.70	EW:0.65 CC : 0.16	EW: 3.55 CC : 1.42	EW : 13% CC : 52.50%
9.	Kaveri Aqueduct at 24608 m	19.06.01	30.11.05	343 -	EW:8.649 CC:15.53	EW:13.908 CC : 12.15	EW : 13.908 CC : 12.26	EW:100% CC : 79%
10.	Paver lining of ISP main canal from 17.00 to 31.284 km Construction of W.B.M. road on service Bank & Earth Work Jalwania, Atud, Kalmukhi distributary alongwith their minors & sub-minor i/c C.C. lining & construction of structure.	01.04.03	01.04.06	1943.54	EW:779 CC:8.612 Lining: 68.513	EW : 95.21 CC : 4.14 Lining: 38.93	EW:156.00 CC : 1.297 Lining: 27.46	EW:33.60% CC : 48.10% Lining 56.83%
11.	Paver lining of iSP main canal from 31.284 to 41.250 km Construction of W.B.M. road on service Bank & Earth Work Sanawad distributary R.D.15.00 to 19.645 km & Lohari distributary along with their minors & sub-minor i/c C.C. lining & construction of structure.	04.07.03	06.01.07	1822.59	EW:660 CC:7.72 lining 51.50	EW : 171.60 CC : - Nil Lining: - 18.02	EW:121 CC : -Nil Lining : - 6.11	EW: 26% CC : -Nil Lining : - 35%
12	Earth work & concrete lining & construction of structure of ISP Sanawad distributary from RID. 0.00 to 15.00 km its minor & sub minor	16.10.03	02.10.05	1993.74	EW:1378.54 CC:27.590 Liing:29.789	EW:661.70 CC:7.44 Liing:1.94	EW:516 CC : 3.31 Lining: 0.94	EW: 48% CC : 27% Lining: 6.2%

The targeted date for completion of various works in this reach has already been over. However, it has been planned to provide irrigation in the 1st phase of the canal by June, 2006.

5.6.3 Structures

It has now been planned to construct 39 structures of main canal out. of which 23 nos. have already been completed. Out of the remaining 16 structures 15 structures are scheduled to be completed by 2006.

5.6.4 Lining and Canal Service Road

As reported in the previous report, the work of construction for lining of main canal, distributary, minor & sub-minor and Water Bound Macadem service road for canal was awarded to the respective agencies.

5.6.5 Land Acquisition

98 Nos of L.A. case has been submitted to L.A.O. The award for 36 Nos land Acquisition cases for 190.972 Ha. has been received and payment has been made.

5.7 Canal Reach : km 41.25 – km 58.856

The works in the reach from km 41.25 to 58.856 have been distributed in three groups; ME-11 km 41.25 to 42.256, ME-12 km 42.256 to 51.50 and ME-13 km 51.50 to 58.856.

The Status of activities in this reach is discussed in the following para:

5.7.1 Land Acquisition :

Total 74 cases of 608.164 ha have been awarded for main canal and distribution system in the canal reach km 41.25 to km 58.856.

5.7.2 Earth work :

The earth work in this reach between km 41.25 to km 42.007 is completed and is in progress between 42.009 to 58.856 km. The status of progress of works in this reach is furnished in the following table:

S. No	Name of works	Award date/date of start	Scheduled completion date	Tender cost Rs. Crores	Total Quantity Th. Cum	Progress		
						Upto 3/05 (Th.cum)	Upto 9/05 (Th.cum)	% progress
1.	Earth work (RD 42.007 km to 45.256 km) including four structures	12.12.00 29.12.00	28.02.06	8.56	EW: 740 CC : 6.06	EW: 740 CC : 4.59	EW: 740 CC : 4.59	EW: 100% CC: 76%
2.	Earth work between (51.50 km to 58.856 km) including construction of 10 Nos. structures & lining works	02.06.03	1.12.05	15.56	EW: 167.122 CC : 5.492 Lining : 24.549	EW: 127 CC : 4.765 Lining : 4.80	EW: 155.42 CC : 5.22 Lining : 18.90	EW: 93% CC : 95% Lining : 77%
3.	Construction of 6 Nos. distribution and its minors (41.25 km to 58.356 km)	02.04.03	30.06.06	23.92	EW: 1409 CC : 46 Lining : 8.1	EW: 564 CC : 3.6 Lining : 0.2	EW: 915.85 CC : 14.26 Lining : 0.32	EW: 65% CC : 31% Lining : 4%
4.	Construction of CC lining by paver machine in ISP Main Canal between 41.25 km to 51.500 km and WBM road between 41.25 km to 58.856 km of ISP Main canal.	20.11.03	19.01.06	8.97	EW: 92 Lining : 34.4	EW: 46 Lining : 3.7	EW: 55.20 Lining : 14.44	EW: 60% Lining : 42%

5.7.3 Structures :

Out of 30 structures planned in this reach 26 have already been completed. Remaining 4 structures are planned for completion during 2005-06

5.7.4 Distributaries :

The work of construction of Roopkheda, Baswa, Delgaon, Dhakalgaon, Nalwa, Neelkanth distributary and its minors and sub-minors is in progress.

5.7.5 Lining and Canal Service Road :

Tenders for lining of Main canal distributories, minors, sub-minors and WBM Road was awarded in November 2003. The scheduled target date for the completion of this work is June 2006. About 50% of the work is completed upto September 2005.

5.8 Canal Reach from km 58.50 to km 107.0

5.8.1 Land Acquisition

Total 1016 ha land required has been acquired for canal in this reach between Km 58.50 and 107.

5.8.2 Earth work

As mentioned in the earlier report, work has been started in this reach. The works on Ahirkheda tunnel and Amba tunnel are in progress. The details of progress of work is given below:

SI No	Name of work (Canal)	Date of work order	Target date of completion of work	Amount of Contract (Rs. Lakh)	Percentage of Progress upto Sept-2005	
					Physical	Financial
1	Excavation of main canal from km 58.856 to km 64.50 of ISP	04.05.02	03.11.04	955.91	31%	23%
2	Excavation of main canal from km 64.50 to km 70.54 of ISP.	25.06.02	24.12.04	1027.83	79%	88%
3	Construction of Amba tunnel with its approach and exit channel between RD 70540 m. to RD 73370m. of ISP main canal	30.05.02	29.05.05	4191.94	(A) Open exc. 100 (B) Tunneling 99 (C) RCC work 99	99%
4	Construction of 31 Nos. Concrete structure alongwith CC lining with paver machine on main canal of ISP between km 58.856 to km 82.395	23.10.03	22.04.06	4675.15	(A) Earth work Nil (B) Structure – 8 No (C) Lining – 20km	28%
5	Excavation and earth work of main canal between km 73.370 to km 75.820 of ISP	24.05.02	23.11.04	<u>1266.26</u> 1373.90 (Revised)	100	100
6	Excavation and earth work of main canal between km 75.820 to km 79.520 of ISP	24.06.02	23.11.04	<u>1068.24</u> 1516.06 (Revised)	96%	96.77%
7	Construction of Ahirkheda tunnel with its approach and exit channel between RD 79520m to RD 82395m of ISP main canal	10.01.03	09.07.05	3953.47	(A) Open exc. 93% (B) Tunneling 98% (C) RCC work 39%	83%
8	Earth work of main canal construction of 10 Nos. CC Structure of CC lining work with paver machine on main canal of ISP between km 82.395 to km 89.710	01.09.03	28.02.06	3921.34	(A) Earth work – 94% (B) Structure – 20%. (C) Lining – 54%	92%
9	Earth work for Ambak River	31.01.04	30.03.04	34.14	100	100

	Straightening between km 76.020 to 76.660					
10.	Design and construction of aqueduct on ISP main canal at RD 95.80 km On river Veda, RD 106.00 km On river Bhayakheda and RD 107.40 km On river Kunda	28.11.03	27.06.05	1260.00	100	100
11.	Earth work, construction of 16 Nos. structures & C.C. lining of Main Canal from km 89.710 to 95.770	09.09.04	08.03.07	1841.85	(A) Earth work – 84% (B) Structure –19% (C) Lining 26.5%	69%
12.	Earth work, construction of 11 Nos. structures & C.C. lining of Main Canal from km 96.030 to 107.30	09.09.04	08.03.07	2397.25	(A) Earth work – 81% (B) Structure –30% (C) Lining-24%	62.59%

5.8.3 Structures

There are 74 structures out of which 18 Nos have been completed up to March 2005 and 16 structures are in progress.

5.8.4 Survey & Design of Khargone Lift and Disnet between Km 80.0 to Km 125 of ISP Main Canal.

Preliminary survey of the Khargone Lift Branch canal from Km 0.0 to Km 83 has been completed and alignment is under finalization. Tenders for survey for three groups of Khargone lift canal and one group for all distributaries and minor off taking from km 80.0 to 125 of ISP main canal have been awarded by NVDA and works started. Status of progress of works up to Sept. 05 are as follows:

S No	Name of Work	Agreement No.	Date of Work Order	Name of Contractor	Stipulated Date of completion	Status of	
						Survey	Design
1	2	3	4	5	6	10	11
1	Survey, Planning, Design & Estimate of Khargone lift Canal System from km 0 to 18 – Group-I	5/2002-03	16.01.03	Hydropneum Systems Pune (M.S.)	<u>16.07.03</u> 31.12.03 Revised Date	Completed	Completed
2	Survey, Planning, Design & Estimate of Khargone lift Canal System from km 18 to 56 – Group-II	6/2002-03	16.01.03	M/s.Tritech Engineering Project, Pune (M.S.)	<u>16.07.03</u> 31.12.03 Revised Date	Completed	Completed
3	Survey, Planning, Design & Estimate of Khargone lift Canal system from km 56 to 83 – Group-III	7/2002-03	16.01.03	Hydropneum Systems Pune (M.S.)	<u>16.07.03</u> 31.12.03 Revised Date	Completed	Completed
4	Survey, Planning, Design & Estimate of Indira Sagar Project Main Canal from km 80 to 125-Group IV	8/2002-03	±6.01.03	M/s.Tritech Engineering Project, Pune (M.S.)	<u>16.07.03</u> 31.12.03 Revised Date	Completed	Completed

5.9 Canal Reach : Km 107 to Km 125

The alignment of main canal from km 107 to km 125 has been finalised and technical sanction to the estimate has also been accorded.

As per directives of NVDA, Tenders in two groups i.e. between Km 107.74 to 114.73 km of Rs. 2506 lakhs and Km 114.073 to Km 125.0 for Rs. 4608 lakhs are to be invited.

5.9.1 Land Acquisition :

The 11 cases of 165 ha have been submitted to L.A.O.

5.10 Canal Reach : Km 125 to Km 206

The main canal alignment has been finalized up to RD 150 km and the alignment between Km 151 to 206 km in under the process of finalisation. The status of work is as under:

S. No	Name of Work	Agreement No.	Date of Work Order	Name of Contractor	Stipulated Date of completion	Status of	
						Survey	Design
1	2	3	4	5	6	10	11
1	Survey, Design, Drawing & Estimate of distributaries, minors and sub minor of I.S.P. main canal and provide distribution system 40 ha. chak maps from RD 125 to 150 km	4/DL/02-03 dt. 13.3.03	No. 683 dt 13.3.03	M/s Samarth Engineers U.D.Kande, Manoj Deshpande Pune(J.V.)	<u>13.09.03</u> 30.04.05 Revised	Completed	Under progress
2	Survey, Design, Drawing & Estimate of distributaries, minors and sub minor of I.S.P. main canal and provide distribution system 40 ha. chak maps from RD 150 to 176km	4/ of 02-03 dt. 28.8.03	No. 437 dt 28.2.03	M/s Samarth Engineers U.D.Kande, Manoj Deshpande Pune(J.V.)	<u>27.8.03</u> 28.9.04 Revised	Under progress	Under progress
3	Survey, Design, Drawing & Estimate of distributaries, minors and sub minor of I.S.P. main canal and provide distribution system 40 ha. chak maps from RD 176 to 182 km	1 of 02-03 dt. 18.02.03	No. 217 dt. 18.2.03	M/s Tritech Engineering Project Pune (M.S.)	<u>17.08.03</u> 31.12.04 Revised	Under progress	Under progress
4	Survey, Design, Drawing & Estimate of distributaries, minors and sub minor of I.S.P. main canal and provide distribution system 40 ha. chak maps from RD 182 to 190 km	2 of 02-03 dt. 18.2.03	No. 219 dt. 18.2.03	Hydropneum Systems Pune (M.S.)	<u>17.08.03</u> 17.02.04 Revised	Under progress	Under progress
5	Survey, Design, Drawing & Estimate of distributaries, minors and sub minor of I.S.P. main canal and provide distribution system 40 ha. chak maps from RD 190 to 206 km	3 of 02-03 dt. 18.02.03	No. 221 dt. 18.02.03	M/s Tritech Engineering Project Pune (M.S.)	<u>17.08.03</u> 17.02.04 Revised	Under progress	Under progress
6	Survey, Design, Drawing & Estimate of distributaries, minors and sub minor of I.S.P. main canal and provide distribution system 40 ha. chak maps from RD 131 of ISP Main canal	3/DL/02-03 dt. 24.02.03	No. 559 dt. 28.02.03	Hydropneum Systems Pune (M.S.)	<u>27.08.03</u> 30.05.05 Revised	Under progress	Under progress

CHAPTER-6: INSTRUMENTATION AND SEISMOLOGICAL OBSERVATIONS

6.1 GENERAL

In order to study and conduct regular monitoring of various parameters and behavior of dam under different reservoir operation conditions, the dam instruments have been installed in over flow block No.24 & 25 on the right flank of dam and overflow block No. 13,14 in the river portion and overflow block no. 5 in the left flank of the dam.

6.2 INSTRUMENTS DEPLOYED FOR MONITORING

The details of instruments deployed for monitoring of various parameters such as uplift pressure, movement in foundation, stresses strains, temperature in the body of dam, differential movement of block of dam, inclination etc. are given in table below.

INSTRUMENTS DEPLOYED FOR MONITORING OF VARIOUS PARAMETERS

Sl. No	Description	Location				Total
		O.F. Block 13/14	N.O.F Block 24/25	Block No.5	Block No.6	
1	Foundation Piezometer	15	08	-	-	23
2	Pore Pressure Cell	05	04	-	-	09
3	Stress Meter	08	07	-	-	15
4	Strain Meter Spider (set of 5)	04	08	-	-	12
5	No Stress Strain Meter	04	08	-	-	12
6	Joint meter	28	10	-	-	38
7	Thermometer	30	16	03	04	53
8	Extensometer	01	01	-	-	02
9	Clinometers	03	02	-	-	05
10	Plumb Line	01	01	-	-	02
11	Seepage Water Meter	02	-	-	-	02
12	Reservoir Water Level Transducer	01	01	-	-	02
13	Uplift Pressure meter	10	05	-	-	15
				Total		190

The job of supply and installation of Dam instrumentation has been excuted to M/s Encardio-rite Electronics Pvt. Ltd., Lucknow.

In order to have on line data monitoring facilities from all installed vibration wire type transducer in Dam control on the right bank of dam, the latest version of Central Data Acquisition System is proposed to be installed which is under procurement process.

6.3 BRIEF DETAILS OF INSTRUMENTS INSTALLED AND THEIR BEHAVIOUR

6.3.1 Foundation Piezometer

These are vibrating wire type having range 0-10 Kg/sq cm with accuracy of 0.5% of range.

No. of Foundation Piezometers installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
11 nos.	13	0-10Kg/sq cm	0	4.0 Kg/sq cm
04 nos.	14	0-10Kg/sq cm	0	1.9 Kg/sq cm
08 nos.	25	0-10Kg/sq cm	0	0.5 Kg/sq cm

6.3.2 Pore Pressure Meter

Pore Pressure Meter are installed to monitor pore pressure within the dam. These are vibrating wire type having range 0-10 Kg/sq cm with accuracy of +/- 0.5% of range.

No. of Pore Pressure cells installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
05 nos.	13	0-10 Kg/sq cm	0	1.0 Kg/sq cm
04 nos.	25	0-10 Kg/sq cm	0	2.0 Kg/sq cm

6.3.3 Stress Meter

The stress meters are located mainly in the bottom most part of the dam, at upstream face and in the toe, as significant stress concentrations would occur at these locations. The stress meter measures stresses at the interface of concrete and foundation. These stress meters are float jack, vibrating wire type with overall thickness to diameter ratio of less than 0.03%. These are vibrating wire type having range 0-2- Kg/sq cm with an accuracy of 0.05% of the range.

No. of Stress Meters installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
08 nos.	13	0-10Kg/sq cm	0	3.0 Kg/sq cm
07 nos.	25	0-10Kg/sq cm	0	9.8 Kg/sq cm

6.3.4 Strain Meter Spider

The strain meters are installed to enable measurement of strains in vertical, horizontal and at 45 degrees to the vertical plane. Strain meters are fixed in a spider configuration with 5 strain meters per spider at each location. Each strain meters is vibration type of range 0-3000 micro meter/meter and resolution of 1 micro meter/meter. The location for strain meters are so selected that a thermometer and a no stress strain meter are in close vicinity. This helps in eliminating errors due to temperature, autogenously growth and creep.

No. of Strain meter installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
04 nos.	13	+/-3000 u Strain	- 21 u Strain	90 u Strain
08 nos.	25	+/-3000 u Strain	- 600 u Strain	1300 u Strain

6.3.5 No Stress Strain Meter

At each location of strain meter spider “ No stress strain meter “ has been installed. No stress strain meter is subjected to the same overall conditions as the surrounding concrete except structural stress there by enabling computation of correct strain value due to structural stress. No stress strain meters are vibrating type of range 0-3000 micro meter/meter and resolution of 1 micro meter/meter.

No. of NSS meter installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
04 nos.	13	+/-3000 u Strain	-14.0 u Strain	35.0 u Strain
08 nos.	25	+/-3000 u Strain	40.0 u Strain	130.0 u Strain

6.3.6 Joint Meter

Joint meters are installed to measure the movement between the adjacent block in the direction of longitudinal, vertical, horizontal and perpendicular of the dam axis.

No. of Joint Meters installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
10 nos.	13	+/- 50 mm	-1.0 mm	7.0 mm
10 nos.	25	+/- 50 mm	-7.0 mm	21.0 mm
18 nos.	13/14,14/15,15/16	+/- 25 mm	-1.0 mm	1.0 mm

6.3.7 Thermometer

Thermometer are installed for measurement of mass concrete temperature. These are vibrating wire type having range 0-60 degree Celsius with accuracy of 0.1 degree Celsius.

No. of Thermometers installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
37 nos.	13,5,6	0-60 degree C	20.0 degree C	40.0 degree C
16 nos.	25	0-60 degree C	19.0 degree C	43.0 degree C

6.3.8 Extensometer

Extensometers are installed for foundation settlement monitoring. This is vibrating wire type sensing head and rebar grout anchor. The range of extensometer is 0-60 mm with overall accuracy of +/- 0.5%.

No. of Extensometer installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
01 nos.	25	+/- 60 mm	0	0.3 mm
01 nos.	13	+/- 60 mm	0	0.3 mm

6.3.9 Clinometer

Clinometers are installed to monitor the localized dam tilts in respect to bottom. The range of 2.0 degree with overall accuracy 0.1%.

No. of Clinometers installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
03 nos.	13	+/- 2.0 degree	0	0.3 degree
02 nos.	25	+/- 2.0 degree	0	0.3 degree

6.3.10 Direct Plumb Line

The direct plumb line are installed to monitor over all inclination/ deflection of the dam. These types of instruments are monitored by using two orthogonally placed traveling microscopes to an accuracy of 0.1mm. The above systems are installed in block No. 24 at (EL-267 to 217 meter) and in Block No. 14 at (EL 265 to 186 meter).

6.3.11 Seepage Water Measurement System

Seepage water measurement system with "V notch" weir has been installed inside gallery of Indira Sagar Dam at Block No. 22, EL-219.0 meter for measurement of seepage water.

6.3.12 Reservoir Water Level Transducer

A vibrating wire type pressure transducer similar to the piezometer is installed at upstream face of the dam directly in connection of the reservoir water to monitor the reservoir level. The range of 0-60 m with overall accuracy +/- 0.5%.

No. of Water Level Transducers installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
01 nos.(Base EL-213.1m)	13	60 meter	0	31 meter
01 nos.(Base EL-223.7m)	25	60 meter	0	21 meter

6.3.13 Uplift Pressure Pipe

These types of instruments are installed to monitor foundation pore pressure through manual burden gauges in addition to vibrating wire type foundation piezometer. For measurement of uplift pressure in foundation, these are Borden Gauges type having range 0-10 Kg/sq cm.

No. of Uplift Pressure Pipes installed	Block No.	Instrument range	Typical observed data range	
			Minimum	Maximum
08 nos.	13	0-10Kg/sq cm	0	1.0 Kg/sq cm
02 nos.	14	0-10Kg/sq cm	0	0.5 Kg/sq cm
05 nos.	25	0-10Kg/sq cm	0	0.3 Kg/sq cm

6.4 ACQUISITION & ANALYSIS OF INSTRUMENTATION DATA

The acquisition and analysis of data are being done by M/s Encardio Rite Electronics Pvt. Ltd., Lucknow on fortnightly basis as per the provisions of the Dam instrumentation Contract. CWPRS, Pune has been appointed as consultant for advice, selection, testing, supervision during installation and data analysis & interpretation of Dam Instrumentation data for a period of 3 years i.e. up to Dec. 2005 and same is being extended for another period of two year i.e. up to Dec. 2007. Data interpretation and analysis report of Dam instrumentation data for a period up to Dec. 2004, has been received from CWPRS, Pune and for period beyond Dec. 2004, CWPRS, Pune pursued vigorously to furnish the report on priority.

6.5 SEISMOLOGICAL OBSERVATIONS

In order to study the effects of seismic events on Narmada Sagar Complex projects, a network of ten seismological observatories with sophisticated instruments is established based on the recommendations of Dam Review Panel, Central Water and Power Research Station, (CWPRS) Pune and Indian Meteorological department (IMD) for monitoring pre and post impoundment seismic parameters in the vicinity with the view to assess the adequacy of seismic parameters adopted for designs.

6.5.1 Present Status of seismic monitoring

A high level committee has been set up by NHDC for monitoring seismic observatories headed by Chief Engineer I/C (Civil) ISP, NHDC. The committee discussed for effective monitoring of seismicity. Accordingly, action has been initiated to achieve the desired goals. The actions being taken are as follows:

1. **Seismic Data acquisition from Micro-Earthquake Recorders:** As per the recommendation of CWC and IMD New Delhi, eleven Micro Earthquake (MEQ) recorders of 800B Model were procured, of which 10 are installed at (i) Narmada Nagar (ii) Omkareshwar (iii) Maheshwar (iv) Khandwa (v) Barwani (vi) Chhanera (vii) Indore. (viii) Kannod (ix) Hirapur (Handia) and (x) Bagli. At present, seismic data are being observed at these locations. The pre and post impoundment data are collected and significant local earthquakes are analyzed. It is also being ensured that seismic data from the MEQ recorders are collected without interruption as the Indira Sagar reservoir is partially impounded upto RL 255.00 m. as per the Court decision. The reservoir may be filled up to FRL during the coming monsoon 2006 depending upon High Court decision in this regard.
2. **Data Acquisition and analysis of Digital/Analog seismic recorders:** The complete package of digital and analog seismic recorders and sensors had been procured from M/s. Sprengnether Inst. Inc. USA and installed at ten observatories. Due to irregular A.C. power supplies at most of the seismic stations, the digital data could not be recorded.
3. **Wood Anderson Seismograph:** IMD had recommended to install Wood Anderson seismographs at six locations namely Narmada Nagar, Omkareshwar Khandwa, Maheshwar etc. The seismologist visiting ISP suggested that seismic data collected through digital seismograph are more reliable as compared to the Wood Anderson seismograph hence further installation is not required.
4. **Procurement of Solar Photovoltaic System:** The A.C. power supply at the stations is affected by power cuts, hence to ensure reliable power supply, Installation of Solar Photovoltaic system at five seismic observatories Narmada Nagar, Kothi, Chhanera, Hirapur and Kannod have been installed on experimental basis and upon their successful performance, the same shall be installed in other observatories as well.

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5. **Upgradation of existing digital recorders:** The existing digital recorders have 2 MB data recording capacity and manual time synchronization. On the recommendations of the experts, Digital Recorders of 10 GB capacity with GPS facility for automatic time synchronization are proposed to be procured.
 6. **Conversion of heated pen recording to Ink pen recording version of VR-60 Visual drum recorders :** The visual recorders VR-60 operates on AC power mains. For data recording, costly heat sensitive papers are also required. In order to avoid this 12V DC power ink pen assembly has been installed.
 7. **Running & Maintenance of observatories:** The man power has been deployed for day to day operation, maintenance and watch & ward of seismic observatory station of ISP on contract basis.
 8. **Consumables:** The timely supply of necessary consumables for operating seismic instruments such as Batteries, Smoke recording papers etc. are being entrusted by NHDC as per requirement. The spare parts are also being procured for micro earthquake recording system to ensure functioning of the system.
 9. **Seismicity studies of ISP:** The seismicity studies including analysis interpretation of analyzed data collected from the 10 seismic observatory stations as per need of CWPRS, Pune for a period of 3 years (2004 to 2006). The seismic data so collected are pre analyzed by the NHDC officials and the same data along with the original recorded data sheet are being sent to CWPRS, Pune for detailed analysis and interpretation. Till date original data along with pre analysis done by NHDC officials from the period of year 2002 to 2004 has already been sent to them for detailed analysis and interpretation. CWPRS, Pune has sent the analysis report for the year 2002 and the report for the year 2003 is received recently on dated 04.04.2006. However the report for year 2004 are under examination by CWPRS, Pune and analysis report for the year 2004 is also expected to be received from CWPRS, Pune shortly. For this purpose NHDC is in close contact with the authorities of CWPRS, Pune. The pre analysis of data for the year 2005 is under preparation by NHDC officials and is being forwarded to CWPRS within fortnightly.

6.6 SEDIMENTATION STUDIES OF INDIRA SAGAR RESERVOIR

The partial impoundment has been done in Indira Sagar after plugging of diversion tunnel from 18th Nov, 2003. In order to estimate the rate of sediment deposition in the reservoir sedimentation studies assignment have been entrusted to CWPRS, Pune by NHDC. The remote sensing technique and Integrated Bathymetric Survey (IBM technique) are being adopted for assessment of sediment deposition. The bathymetric survey has been carried out by CWPRS. The final report will be submitted after attainment of FRL. The outcome of the study along with results in detail is required to be sent to NCA for needful.

6.7 Proposal of IMD to acquire observatory of Narmada Nagar

Indian Metrological Department (IMD) has shown their interest to acquire one of the observatories situated at Narmada Nagar, to set up an unmanned seismological observatory which shall be equipped with state of the art seismological equipment and V-SAT, based communication facilities. For this, IMD shall bear the cost of equipment and recurring expenditure. NHDC has already agreed for the same. The representative of IMD visited this observatories on 24/03/2006 for this purpose.

6.8 Annual Maintenance Contract of Instruments installed in Seismic observatories.

In order to ensure smooth running of various instruments a necessity has been felt to have an annual maintenance contract for all 11 no. observatories. As such proposal to have an AMC at advance stage of finalization.

CHAPTER 7:

REAL TIME DATA ACQUISITION SYSTEM FOR INFLOW FORECAST

NCA has taken up implementation of initial phase of Real Time Data Acquisition System (RTDAS) comprising of 26 Stations of different categories in Narmada basin. As reported earlier, the work has been awarded to M/s ECIL in September, 1996 for carrying out the installation and commissioning of the system on a turn key basis. PSC of SSCAC in its 90th meeting has granted time extension to ECIL to complete and handover the project to NCA by 31st December 2005. Indira Sagar is one of the key stations of the network. At this station, eight parameters viz. rainfall, wind speed, wind direction, ambient temperature, relative humidity, reservoir water level, evaporation and solar radiation is automatically measured through sensors and communicated in real time mode to Master Control Center (MCC) at Indore through Data Relay Transponder (DRT) on board KALPANA-I launched in Sept-02. At M.C.C. the data are compiled, processed and interpreted through appropriate hydrological models.

- ◆ The remote station at ISP is also equipped with e-mail facility for two way exchange of data/information between the Project station and MCC at Indore round the clock through this network.
- ◆ Installation of MS pipe with cabin for permanent stilling well of RTDAS has been completed in the non overflow Block No.3 of the main dam by NHDC. The optical shaft encoder type water level sensor has been installed there for communicating water level data to MCC. The dam block No.3 has been raised to RL 266.25 m.
- ◆ NHDC have installed micro wave level measurement based micro pilot instrument, for measuring water level at dam site during monsoon 2004 and they communicate its data through Fax/Telephone to MCC at Indore.
- ◆ The RTDAS Project is being tested continuously during the current monsoon period as per the contractual terms.
- ◆ The process of simultaneous tuning of forecasting software, SSMA and reservoir operation HEC-5, by M/s. ECIL is also under progress. Based on the data of monsoon 2004. they had demonstrated the Software for various sub catchments of river Narmada.
- ◆ As reported earlier, this station is communicating data to MCC, Indore in respect of temperature, relative humidity, wind velocity, wind direction, solar radiation, rainfall, water level & evaporation round the clock (hourly basis).
- ◆ The RTDAS is under process of installation and re-scheduled to be commissioned during monsoon 2005 after its testing. All the 26 Remote Stations had already been installed and made functional for data communications with Master Control Centre (MCC) at Indore. The testing of the project is being carried out during monsoon 2005 for which arrangement has been done by ECIL for the demonstration of Assured Performances in respect of Data Communications and inflow/level fore cast. The foreign consultants of ECIL for software have also visited MCC, Indore for the turning & refinement of softwares. The successful testing of the whole project during a complete monsoon period a contractual requirement for its taking over by NCA. All the stations are presently communicating data with MCC at Indore and any in between failures are being attended to by ECIL. The system will be very useful in getting all hydro-meteorological information, including issue of inflows and flood forecasts upstream of ISP, upstream reservoir regulation and contemplating advance action for safety of dam and allied structures downstream. It will also facilitate decision making for releases to be made to meet requirement of GoG and GoR in accordance with the provisions under Narmada Water Dispute Tribunal (NWDT) Award.

CHAPTER 8: FINANCIAL PROGRAMME & PROGRESS

8.1 ACCELERATED IRRIGATION BENEFITS PROGRAMME

The Indira Sagar Project was included in Accelerated Irrigation Benefit Programme (AIBP), Govt. of India since the year 1996-97 for providing immediate irrigation benefits to the farmers in an area of 36,100 ha under Phase-I in Khandwa and Khargone Districts of Madhya Pradesh. Now, the scheme is extended for all the works of the canal up to 248.64 km. The Govt. of Madhya Pradesh have proposed to include canal lining and canal road work also under AIBP scheme, which has been accepted "in principle" by MOWR, Govt. of India As of September, 2005 Rs. 597.58 crores has been released by Govt. of India against the sanctioned CLA of Rs. 702.58 crores on this account as follows:

(Rs in crore)

YEAR	CLA SANCTIONED	CLA RELEASED	EXPENDITURE ON AIBP COMPONENTS			CLA: STATE SHARE	SHORT- FALL	
			Expected	Actual				
				Dam	Canal			Total
1996-97	50.00	37.50	75.00	72.22	13.31	85.53	1:1	NIL
1997-98	52.00	51.00	102.00	79.89	16.28	96.17	1:1	5.83
1998-99	75.00	37.50	80.83	80.43	17.64	98.07	1:1	NIL
1999-00	40.00	40.00	60.00	35.77	24.22	59.99	2:1	NIL
2000-01	80.00	80.00	120.00	57.85	31.10	88.95	2:1	31.05
2001-02	23.00	23.00	65.55	NA	68.28	68.28	2:1	NIL
2002-03	124.56	74.01	92.51	22.00	105.02	127.02	4:1	NIL
2003-04	133.08	129.63	170.35	NA	136.28	136.28	4:1	34.07
2004-05	124.94	124.94	166.09*	NA	166.09	166.09	4:1	NIL
2005-06	Nil	Nil	---	---	72.22	---	4:1	Nil
Total	702.58	597.58	1096.88	348.16	650.44	926.38		

Source: Narmada Basin Organisation, CWC, Bhopal

The Proposal for Sanction of CLA of Rs.170.70 crores has been submitted by NVDA which is under consideration of Central Water Commission. However an expenditure of Rs. 72.22 crores on canal has been done during the period April, 2005 to September, 2005.

8.2 BUDGET PROVISION

The Budget provision for the year 2005-06 of NHDC for Unit-I & Unit-III is Rs.107.98 crores. For Unit-II, NVDA, Govt. of Madhya Pradesh has kept budget allocation of Rs 214.47 crores for year 2005-06.

8.3 EXPENDITURE INCURRED DURING FINANCIAL YEAR 2004-05

Unit wise expenditure during the half yearly period ending September, 2005 cumulative expenditure up to March, 2005 and September, 2005 alongwith budgetary provision for the year 2005-06 are given in the following table:

(Rs. In crore)					
Sl. No	Major Head	Cumulative Expenditure up to March, 2005	Expenditure during the financial year (2004 -2005) from April 05 to Sept.05	Cumulative expenditure up to September, 2005	Budget provision for 2005-06
1.	Unit – I: Dam	2460.82	184.08	2644.90	107.98
2.	Unit-III: Power House	1123.64	4.24	1127.88	
3.	Unit-II: Canal	743.20	72.21	815.14	214.47
TOTAL		4327.66	260.53	4588.19	322.45