

Annex IX Dam Safety Management Plan

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9.1 Background

The GoO has a State Dam Safety Organisation (SDSO) that is responsible to provide safeguard mechanism and undertake regular monitoring of dams having height of 15 meters and above. Orissa has 204 numbers of large dams (as per ICOLD classification). This includes 10 major project dams, 50 medium project dams and rest 144 dams under minor irrigation projects. The SDSO has a dam safety review panel that undertakes a detailed appraisal of dams once in ten years as per International Commission on Large Dams (ICOLD) and Central Water Commission (CWC's) dam safety norms. In case of any emergency, it has provision of providing immediate services against the request of minor irrigation department for an assessment of dam safety status; otherwise SDSO only focuses on major concrete dams.

It is important to mention here that with respect to the quality assurance for the tanks, the GoO has agreed to use this Dam Safety panel to help in active monitoring of the minor irrigation tanks covered under OIIPCRA project on a regular basis. The dam safety panel comprises of qualified hydrologists, structural engineers and geologists. It has also been agreed that the panel will support review of dam safety measures in case of tanks having dam height of 10 meters and above. Based on preliminary survey and identification, it appears that there are thirteen dams above the height of 10 m out of which three dams are above height of 15m covered which would require dam safety measures as per OP 4.37 of the World Bank policies. The three dams above 15m Jaunria, Kalimati, and Bahiya have been assessed by State Dam Safety Review panel under DSO practices in 2006, 2007 and 2019 respectively.

The table below provides a summary of the identified dams of height (10-15m) and above 15m height.

Table 1: MIPs with dam height >10m considered under OIIPCRA

Sl. No.	Name of MIP	Catchment (Sq Km)	River Basin	Water Surface Area (Ha)	Dam Height (in m) *	Dam Length (in m)	Type
1	Jaunria, Bhangamunda, Harichandanpur,	24.6	Baitarani	37.5	15.46	814	Earthen

Sl. No.	Name of MIP	Catchment (Sq Km)	River Basin	Water Surface Area (Ha)	Dam Height (in m) *	Dam Length (in m)	Type
	Keonjhar						
2	Kalimati, Balipokhari, Harichandanpur, Keonjhar	32.2	Baitarani	71.7	15.54	915	Earthen
3	Bahiya, Taratara, Hatadihi, Keonjhar	5.2	Baitarani	7.9	21.336	123	Earthen
4	Mathanpala, Bijepur, Titlagarh, Balangir	48.6	Tel	145.0	13.5	1450	Earthen
5	Jamunasagar, Duarsuni, Bhawanipatna, Kalahandi	19.4	Tel	25.8	10.15	420	Earthen
6	Garh, Dhakotha, Anandpur, Keonjhar	21.5	Baitarani	53.8	12.2	681	Earthen
7	Taradia, Kodapada, Anandpur, Keonjhar	22.5	Baitarani	32.4	10.66	271	Earthen
8	Sindhei, Bhandaridiha, Ghasipura, Keonjhar	39	Baitarani	75.0	11.6	1577	Earthen
9	Raghubeda, Santarapur, Ghatagaon, Keonjhar	11.5	Baitarani	10.6	14.8	710	Earthen
10	Jagadala, Malada, Jhumpura, Keonjhar	45.3	Baitarani	37.0	10.68	1018	Earthen
11	Nedam, Sarisapal, Bangriposi, Mayurbhanj	7.8	Budhabalanga	12.3	10	610	Earthen
12	Japimaska, Baliguda, Baliguda, Kandhamal	3.89	Tel	1.9	12.19	137.2	Earthen
13	Kumudabadi, Hatiagarh, Jashipur, Mayurbhanj	10.1	Baitarani	3.2	13.71	494.4	Earthen

* as per design parameter

Table 2: Assessment of major dams covered under Dam Safety Panel

Sl. No.	Name of MIP	Reference Report	Key Observations (summary)
Dam height > 15 meter			
1	Jaunria, Bhangamunda, Harichandanpur, Keonjhar (Expert Panel - March 2007)	March 2007-Expert Panel	<ol style="list-style-type: none"> In Left H.R, The screw gear box of the emergency gate has been stolen for last couple of years. Leakage is noticed at the corner of the left abutment and return wall of spillway as the flowing water will gradually carry the mortar from masonry joints. There is localized depression in the upstream rip-rap between RD 200m to 275m. Due to rain some erosion / sloughing are noticed between RD 215m to 240m just above the rock toe. Rain cuts are there on the downstream slope between RD 520m to 600m. There is some vegetation growth on the upstream and downstream slopes. The toe drain and outfall drain have been choked. The most critical is the condition of falls constructed across the spill channel to negotiate the difference of head. Due to flood of 1993 and 1999, following damages have occurred. <p>1st Fall</p> <ul style="list-style-type: none"> Foundation of end still basin eroded. Guide wall downstream of apron has been damaged. Left earthen guide bund between 1st and 2nd fall washed away thus forming a new channel for passage of flood water. There is leakage of water between the body wall of the fall and the left abutment. Rough stone packing has also been washed away. <p>2nd fall</p>

Sl. No.	Name of MIP	Reference Report	Key Observations (summary)
			<ul style="list-style-type: none"> • Left abutment upstream portion has collapsed. • The downstream portion of the left abutment has tilted. • Body wall of the fall has suffered damage in the middle portion and RCC capping has given way for about 10m. • Dented sills are also damaged. • The left guide bund between 2nd and 3rd fall has been washed away for approximately 10m including collapse of wing wall. <p>3rd fall</p> <ul style="list-style-type: none"> • Loose stone apron provided in the downstream has been disturbed. • The spill channel meet s parent nallah at a distance of nearly 25m from the end sill. <p>Operation and maintenance procedure</p> <p>Unless routine and regular maintenance is carried out, the minor distress will aggravate.</p>
2	Kalimati, Balipokhari, Harichandanpur, Keonjhar (Expert Panel - March 2007)	March, 2007- Expert Panel	<ol style="list-style-type: none"> 1. There is leakage through the weep holes of both abutments of spill way and through crack on left abutment wall. 2. Leakage is observed in the downstream slope of earth dam adjacent to the right abutment wall. 3. Minor depression also has been observed adjacent to the upstream wing wall of right abutment, indicating possible development of piping. 4. Leakage is also noticed above the H.R barrel at the downstream toe of the earth dam. 5. A 1.20m (400 ft) deep sink hole has occurred in the upstream slope of dam at the junction to masonry wall of the gate well. <p>Operation and maintenance procedure</p> <p>There is no operational rule for the project as the spill way is un-gated. Painting, greasing and oiling of gates of the head regulator and hoising system should be taken up regularly on priority basis.</p>
3	Bahiya, Taratara, Hatadihi, Keonjhar	February, 2019- (DSRP-2)	<p>The toe drain and portion of rock toe has been silted up.</p> <p>There is no arrangement to measure the seepage.</p> <p>There is leakage of water from Head regulator.</p> <p>There are some leakage of water through bottom rock foundation of spillway.</p> <p>The downstream slope of the earth dam has been eroded severely due to absence of surface drainage arrangement.</p> <p>Both service and emergency gates of H.R. requires painting and lubrication.</p> <p>Routine maintenance like preparing the rain cuts, clearing the toe drain and removing vegetation growth may be done on priority basis.</p>
Dam height $\geq 10 < 15$ meter			
1	Mathanpala, Bijepur, Titlagarh, Balangir	06/ 02/ 16- DSO Team and 22/ 05/ 14- Executive Engineer M.I Division, Bolangir	<p>There is provision of toe drain only for 180.00m length of dam which is fully silted up.</p> <p>There is no well-defined outfall drain. It is full of grasses and silt.</p> <p>Surface drainage in D/S slope is not available.</p> <p>Dam top width is less than 3.00m against the design width of 3.66m. There is depression / undulations at many patches having no all weather road.</p> <p>There are some hair cracks developed on the top of dam. The edges of dam is eroded due to surface runoff resulting in reduction of effective width. There is no parapet wall. The edge of dam is having insufficient number of guard stones</p>

Sl. No.	Name of MIP	Reference Report	Key Observations (summary)
			<p>There are undulation/ depressions at many places in both U/S and D/S slopes. The D/S slope is full of rain cuts and ant hills. There is profuse growth of grasses and bushes.</p> <p>The rock toe is chocked due to deposition of silt over it as D/S slope is eroded due to surface runoff at several locations.</p> <p>The wearing coat over the surplus escape has been damaged. Leakage through the the foundation of surplus</p> <p>Escape is noticed.The existing seepage measurement is by float method.</p> <p>There is leakage in outlet well as well as in gate. Enormous noise is generated during operation of gate. There is no catwalk to operative platform of outlet gate.</p> <p>The stone packing after 1st fall is completely damaged. As it appears the heavy scouring is occurring due to steep fall. Retrogression is noticed beyond the left bank protection wall in tail channel.</p> <p>Emergency Action Plan is not yet prepared.</p> <p>The overall health status of dam is in good for normal operation.</p>
2	Jamunasagar, Duarsuni, Bhawanipatna , Kalahandi	December, 2006- Expert Panel	<p>There are slushy patches with occurrence of seepage is noticed at RD 180.00m near the toe of the dam. There is no defined outfall drain. There is profuse weed growth and raincuts in some location of d/s slope. u/s packing is disturbed in some locations.</p> <p>Leakage is seen at RD 150m of d/s side of earth dam</p> <p>Seepage measurement is not conducted as there is no instrument for the purpose.</p> <p>Crest profile has been heavily undulated. The wheel tracks and pot holes are present abundantly. The edges are not in proper profile. The earthen road is existing on crest of the dam. There is no provision of steps to top of the dam.</p> <p>Conduit pipe of the head regulator is damaged. Water supply to the canal was provided by cutting the flank in the left side of the HR as a temporary arrangement.</p> <p>From 3rd to 6th fall of the surplus escape, the existing abutment retaining walls of masonry structure is in damaged condition.</p> <p>Emergency Action Plan is not prepared</p> <p>The earth dam top and slopes are settled and eroded and not in proper section. The d/s turfing has been damaged.</p> <p>The pointing in return wall & abutment wall is damaged.</p> <p>No painting work has been done to the surface of outlet gates.</p> <p>The d/s channel is getting scoured day by day severely.</p>
3	Garh, Dhakotha, Anandpur, Keonjhar	19/ 12/ 17- DSO Team and 01/ 06/ 15- Executive Engineer, M.I Division, Anandapur	<p>The catchment area intercepted at dam site is 21.50sq.km. The design flood adopted is 194.00 Cumec.</p> <p>No geological investigation was carried out either project preparation stage or during construction period.</p> <p>The toe drain is silted up. Stagnant pool of water is observed adjacent to the toe of the dam at RD 500m-600m due to a high land adjacent to the toe of the dam near RD500m. The outfall drain is not in proper shape & grade. Vegetation growth is observed in the toe drain area as well as in the outfall drain area.</p> <p>Surface drainage arrangement on the D/S slope has not been provided.</p> <p>V-notch installed earlier has been damaged.</p> <p>The edges of crest have eroded at some locations resulting reduced effective width of dam top. The ramp is damaged. Dam top road is of earthen surface. Neither parapet wall nor guard stones are provided on dam top.</p> <p>U/S pitching has been disturbed at some locations. Rain cuts are there on the D/S slope of the earth dam The Rock toe has been silted up. D/S turfing has been damaged at patches. Tree growth and ipomoea, grass and other</p>

Sl. No.	Name of MIP	Reference Report	Key Observations (summary)
			<p>vegetation growth is observed on U/S & D/S slope. Ant hills are there on the D/S surface of the dam.</p> <p>Cracks are observed on the surface of the spillway body.</p> <p>Vegetation growth is observed over the stilling basin. Plastering of the 1st fall has been damaged. Apron packing after 2nd fall has been disturbed.</p> <p>Water is leaking through the left and right abutment at RL 75.75m.</p> <p>Necessary instruments like V-Notch, Piezometer are not installed.</p> <p>Right HR gate is not functioning since long.</p> <p>Emergency Action Plan is not prepared</p> <p>U/S riprap has been disturbed at different places.</p> <p>Guard stones & chainage stones are not provided on top of dam.</p> <p>No Longitudinal and cross drains are provided.</p>
4	Taradia, Kodapada, Anandpur, Keonjhar	03/ 06/ 16- Executive Engineer, M.I. Division, Anandapur and 03/ 06/ 15- DSO Team	<p>U/s rip rap has been disturbed in few locations & vegetation growth was also found in the u/s slope.</p> <p>The river/nalla portion is not clear for effective flow of seepage water.</p> <p>Guard stones & chainage stones are not provided on top of dam.</p> <p>Necessary instruments like V-Notch, Piezometer are not installed.</p> <p>No Longitudinal and cross drains are provided.</p> <p>Leakage is noticed through the outlets in its closed position. The surface of the gates and painting is deteriorated. The connecting bolts are loosed/damaged and the rubber seals are damaged.</p> <p>Leakage water is observed in d/s left side abatement.</p> <p>Tail channel is retrograded at a distance of 130mtr from the spillway. The 2nd and 3rd grade wall provided earlier are fully damaged.</p> <p>Rock toe is buried under soil & Toe drain is silted.</p> <p>Vegetation growth was found on d/s slope & the turfing was damaged. Rain cuts were also seen.</p> <p>Spillway is un-gated.</p> <p>There is one Service gate & one Emergency gate and both are not functioning. Painting is deteriorated. Gate shaft is found tilted. Lubrication of gates damaged.</p> <p>The tail channel has been retrograded for a distance of 70m from the spillway where the first fail structure was built. Two Grade walls at RD 180m & 300m have been collapsed completely.</p> <p>The reservoir is safe for normal operation, but immediate repair & restoration of appurtenant structures is essential.</p>
5	Sindhei, Bhandaridiha, Ghasipura, Keonjhar	03/ 06/ 16- M.I. Division, Anandpur, Keonjhar and 03/ 06/ 15- DSO Team	<p>RR stone masonry of the free board portion has been damaged.</p> <p>Upstream rip-rap has been disturbed in few locations between RD 0.00m to 590.00m. Vegetation growth was also found in the u/s & d/s slopes. Slope erosion and rain cuts have developed in d/s slope due to public using the berm as walk path.</p> <p>Guard stones & chainage stones are not provided on top of dam.</p> <p>Wet patches/seepage is noticed on the d/s of dam within 200m from the toe of the dam.</p> <p>There is settlement and displacement of stones in the rock toe. Abnormal leakage is noticed through the rock toe in gorge position.</p> <p>Necessary instruments like V-notches are not installed for measurement of seepage.</p> <p>No longitudinal and cross drains are provided.</p> <p>Leakage water is observed in d/s left side abutment.</p> <p>Tail channel is retrograded at a distance of 60mtr from the spillway. The grade wall provided earlier is fully damaged.</p> <p>Spillway is un-gated</p> <p>There is one head regulator at RD 192.0m. There is one service gate & one</p>

Sl. No.	Name of MIP	Reference Report	Key Observations (summary)
			Emergency gate and both are functional. But painting has deteriorated. Leakage is observed in d/s of left side wing of HR. Stray boulders are found inside head regulator bay. Minor cracks found on the skin of body weir along with calcinations marks. The stilling basin is dry on the day of inspection but there were deposits of stones in it. Overall condition of the energy dissipation arrangement is good. The dam is safe for normal operation. Maintenance of Dam & appurtenant structures should be given due importance for maintaining the safety of the dam.
6	Raghubeda, Santarapur, Ghatagaon, Keonjhar	18/ 03/ 17- DSO Team	The U/S & D/S slope of the dam is full of vegetation. Also, the present nallah & outfall drain are covered with trees & bushes. Seepage water is seen in the outfall drain. RD pillars and guard stones are not provided on the dam top. U/S rip-rap & Rock toe of the dam has been completely disturbed. Gully formed at left side butting point of the dam. At extreme left dyke seepage point found near d/s slope. A crack has developed on body of the spillway, also abrasion/pitting observed on the surface of spillway. Boulders have been disturbed in the apron below the stilling basin of the spillway. There is single H/R present in the dam having only service gate. All iron parts lack lubrication. Necessary instruments like Piezometer, V-Notch etc. has yet not been installed The general condition of the dam is good. Regular maintenance is necessary. The dam is safe for normal operation.
7	Jagadala, Malada, Jhumpura, Keonjhar	03/ 12/ 2015- Executive Engineer M.I. Division, Keonjhar and 05/ 02/ 14- DSRP	Horizontal cracks are developed in top of earth dam and heavy rain cuts appeared in d/s slope. U/S rip-rap, D/S toe drain and rock toe needs repair. There is standing pool of water in the d/s area at RD180m, 518m and 820m. Leakage observed on the side of the support wall. V-notches to measure seepage discharge is not yet installed. DSRP has recommends raising of earth dam, installation of solid parapet wall and additional spillway to meet the revised design flood of 630 cumecs against the present design flood of 339.60 cumecs.

9.2 Procedures for Dam Safety Assessment and Monitoring

The project will not support construction of new dams, however some proposed MIPs (as identified in Table above) under OIIPCRA may rely on the performance of existing large dams. The existing dams would need to be evaluated for their safety status and performance history in accordance with OP 4.37 provisions. An effective dam safety operation is already underway in the State of Orissa under the State Dam Safety Organisation. A Dam Safety Panel has been operationalised with key experts for the purpose of OIIPCRA (the TOR attached in Appendix- 1)

The State Dam Safety Panel shall undertake comprehensive review from dam safety and operation and maintenance point of view and recommend the remedial measures for rehabilitation of MI tanks that have

bund height more than 10m considered under OIIPCRA. Within the first 6 months of project implementation, the three dams above 15m height will be re-assessed by DSP. The project will support all costs associated with this review (including ancillary, recurring and non-recurring cost). A report will be prepared by DSP and reviewed by Director DSP and the PMU and subsequently shared with the Bank review.

The State Dam Safety Panel will be guided by the Government of Odisha related legislations, regulations, standards and guidelines, and World Bank’s Operational Policy on Safety of Dams OP 4.37. The DSRP will also monitor the implementation of remedial works for large dams, if needed, and issue guidelines to the field engineers on any remedial measures to be taken for implementation of rehabilitation of these 13 dam (MIP) if needed. The DSP, executive engineer from MI department and PMU representatives will monitor the implementation of the remedial actions recommended as needed.

As per preliminary estimation with SDSO, OIIPCRA and WR department, approximately an amount of Rs. 75 lakhs/- per MI tank (applicable for additional four tank) will be allocated towards maintenance, monitoring and surveillance expenses. Thus total budget for dam safety plan implementation will be 3 crore rupees over a period of 6 years project duration of OIIPCRA.

The following table outlays the procedures that will be followed as per OP 4.37 Safety of Dams

	Mitigation Measures	Responsibility
Pre- Construction / DPR preparation Large Dams	Specifically for large dams (as defined in OP 4.37 above height of 15m) Government of Orissa will arrange for the dam safety panel to (a) inspect and evaluate the safety status of the existing dam, its appurtenances, and its performance history; (b) review and evaluate the O&M procedures; and (c) provide a written report of findings and recommendations for any remedial work or safety-related measures necessary to upgrade the existing dam to an acceptable standard of safety in accordance with the provisions of OP 4.37 annex A (Box 3). For all/ any remedial works proposed, the work be designed and supervised by competent professionals. All recommendations arising from structural assessment will be integrated into the works	State Dam Safety Panel.

	Mitigation Measures	Responsibility
	package and cost for that DPR.	
Pre- Construction / DPR preparation Small Dams (10-15m height)	If selected MIPs incorporate the rehabilitation of small dams/bunds or rely on the performance of small dams below that threshold of 15m, the DPR preparation process will need to ensure standard dam safety engineering measures approved by a qualified engineer/state dam safety panel. Any remedial actions would need to be incorporated in the civil works to be undertaken.	Qualified Engineers in DPR team, State Dam Safety Panel and PMU
Supervision of Remedial works	The DSP will also provide expert inputs to monitor the implementation of remedial works for large dams, and issue guidelines to the field engineers on any remedial measures to be taken for implementation of rehabilitation of these 13 dam (MIP) if needed. General Construction supervision will be undertaken by construction supervision and quality control consultant, who will report to the PMU and MI department.	Dam Safety Panel CSQC consultant
Monitoring	Executive Engineer of MI department from that division will undertake general surveillance as per the checklist in Box 1 M&E agency will also conduct monitoring at Mid-Term and Final Impact assessment as per the checklist in box 2 SODO will also conduct periodic inspection of all these 13 dams at 5 years and 10 years interval respectively as per laid down Govt. norms. Mitigation action will also be taken as per laid down Govt. process.	Executive Engineer MI Department M&E Agency State Dam Safety Organisation

Checklist for general surveillance by executive engineer (as per DSO)

A detailed checklist has been developed to do the monitoring and evaluation of dam safety (for tank and ancillary works) of 13 MIPs with more than 10-meter height considered under OIIPCRA. The details are as given hereunder:

A. Embankment Structures

(a) Settlement: The embankments and downstream toe areas should be examined for any evidence of localized or overall settlement, depressions or sink holes.

(b) Slope Stability: Embankment slopes should be examined for irregularities in alignment and variances from smooth uniform slopes, unusual changes from original crest alignment and elevation, evidence of movement at or beyond the toe, and surface cracks which indicate movement.

(c) Seepage: The downstream face and toes, contact with structures, and the downstream valley areas should be examined for evidence of existing or past seepage. The sources of seepage should be investigated to determine cause and potential severity to dam safety under all operating conditions. Increase or decrease trend of seepage should be monitored. The presence of animal burrows and tree growth on slopes should be examined.

(d) Drainage: Signs of water logging, slushy condition, and standing pool downstream of the dam should be monitored. Conditions of cross drains and out fall drain should be reported.

(e) Slope protection: The slope protection should be examined for erosion, formed gullies and wave-formed notches and benches that have reduced the embankment cross-section or exposed less wave resistant materials. The adequacy of Slope protection against waves, currents, and surface run-off that may occur at the site should be evaluated. The condition of vegetative cover should be evaluated where pertinent.

B. Spillway structures

(a) Spillway: The spillway should be examined to pass the revised designed flood flow. The Leakage through junctions with dam, leakage through the body of spillway, Cracks, peeling of plaster should be noted.

(b) Stilling Basin (Energy Dissipaters): Stilling basins should be examined for scour or erosion which may create or present a potential hazard to the safety of the dam. The existing condition of the channel downstream of the stilling basin should be determined.

(c) Downstream [D/S] Channel: Channel immediately downstream should be examined for conditions for safe passage of flood discharge.

C. Outlet work

The structure and all features should be examined for any condition which may impose operational constraints on the outlet works. Entrances to intake structures and outlet channel should be examined for conditions such as silt or debris accumulation which may reduce the discharge capabilities of the outlet works. The interior surfaces of conduits should be examined for erosion, corrosion, cavitations, cracks, joint separation and leakage at cracks or joints.

D. Safety and performance instrumentation

Instruments which have been installed to measure behaviour of the structures should be examined for proper functioning. The available records and readings of the installed instruments should be reviewed to detect unusual performance or distress of the structure.

Emergency Action Plan [EAP]: An exclusive plan needs to be prepared to meet the emergency

requirements called “Emergency Action Plan” encompassing inundation maps for maximum spillway flood in case of dam breach and preparedness plan for the emergency. Upon finding a hazardous condition that could lead to a dam breach or upon discovering a potential dam breach or dam breach in progress, the project authority shall issue dam breach warnings to inhabitants in areas immediately downstream of the dam.

Pre and Post Monsoon Inspection: Pre-monsoon and Post-monsoon inspection of these 13 dams will be carried out by the field engineers as per the guidelines prescribed by the Central Water Commission (in line with checklist given above). The reports shall be submitted to OIIPCRA along with SDSO by end of June and November, respectively. Each year these reports of inspections will be reviewed at State Dam Safety Organization & the Annual Health status of the dams will be published and sent to Government in Department of Water Resources and Central Water Commission for their appraisal.

Box 1 Checklist for General Surveillance

Dam Aspect	Key Challenges/ Risks	To be monitored in Planning and Implementation phase	Responsibility for implementation
Embankment	Settlement of embankment	Strengthening of embankment by approved engineering methods based on recommendation of expert panel.	Dept. of MI
	Cracks on crest	Repair of cracks on crest as per standard procedure	Dept. of MI
	Concavity of upstream	Restore slope to designed profile by earthwork in benching or with stone riprap depending on depth of concavity.	Dept. of MI
	Rain cuts, ant hills, rodent holes	Repair of rain cuts by back filling. Remove ant hills and rodent holes up to the root and back fill with suitable earth laid in layers duly compacted. White ant treatment to be adopted when problem is wide spread.	Dept. of MI
	Displaced riprap	Removing and repacking of stone riprap with supply of stone as necessary.	Dept. of MI
	Degraded berk of the embankment	Longitudinal slope may be constructed in the berk location, leading to slope drains. Turfing may be adopted where ever required	Dept. of MI
	Invisible toe drains due to weed growth and covered up by soil	Weed growth be cleaned by uprooting. The choked toe drains be cleaned of all earth deposit by removing and repacking. Graded filter below the drains need be replaced	Dept. of MI
	D/S area	Excavate slushy drainage to drain out the area. If required filter drains may be provided.	Dept. of MI
	Lack of surface drainage arrangement	Construct shallow earthen/ masonry drains to drain out the area	Dept. of MI
	Leakage through junctions of dam with outlet barrel and spillway	The leakage path to be investigated opened out and sealed with fresh earth work laid and compacted in suitable layers. Proper bonding with masonry structure to be ensured.	Dept. of MI
Spillway / Surplus weir	Cracks, leakage in spillway	Cracks need to be sealed with cement or epoxy. Source of leakage to be located and same sealed by grouting.	Dept. of MI
	Inadequate spillway capacity	Additional length of spillway to be provided. Encroachment of free board for some extent for short duration may be allowed. Raising of height of the dam to cater to the increased maximum water level may be required.	Dept. of MI
	Degraded Energy Dissipation	Restoration of the energy dissipation arrangement by suitable repair.	Dept. of MI

Dam Aspect	Key Challenges/ Risks	To be monitored in Planning and Implementation phase	Responsibility for implementation
	Arrangement		
	Retgression warranting undermining of parent structure	In specific cases additional drop walls may be constructed in the spill channel. Cut off walls may be constructed to check retrogation/ undermining.	Dept. of MI
Head Regulators / Head sluice	Leakage of water through the Head regulator gates	Repair/ replacement of gates.	Dept. of MI

BP 4.37, Annex A - Dam Safety Reports: Content and Timing

These procedures were prepared for use by World Bank staff and are not necessarily a complete treatment of the subject.

BP 4.37 - Annex A
October, 2001

1. *Plan for construction supervision and quality assurance.* This plan is provided to the Bank by appraisal. It covers the organization, staffing levels, procedures, equipment, and qualifications for supervision of the construction of a new dam or of remedial work on an existing dam. For a dam other than a water storage dam,¹ this plan takes into account the usual long construction period, covering the supervision requirements as the dam grows in height—with any accompanying changes in construction materials or the characteristics of the impounded material over a period of years. The task team uses the plan to assess the need to fund components under the loan to ensure that dam-safety-related elements of the design are implemented during construction.
2. *Instrumentation plan.* This is a detailed plan for the installation of instruments to monitor and record dam behavior and the related hydrometeorological, structural, and seismic factors. It is provided to an independent panel of experts (the Panel) and the Bank during the design stage, before bid tendering.
3. *Operation and maintenance (O&M) plan.* This detailed plan covers organizational structure, staffing, technical expertise, and training required; equipment and facilities needed to operate and maintain the dam; O&M procedures; and arrangements for funding O&M, including long term maintenance and safety inspections. The O&M plan for a dam other than a water storage dam, in particular, reflects changes in the dam's structure or in the nature of the impounded material that may be expected over a period of years. A preliminary plan is provided to the Bank for use at appraisal. The plan is refined and completed during project implementation; the final plan is due not less than six months prior to the initial filling of the reservoir. Elements required to finalize the plan and initiate operations are normally financed under the project.²
4. *Emergency preparedness plan.* This plan specifies the roles of responsible parties when dam failure is considered imminent, or when expected operational flow release threatens downstream life, property, or economic operations that depend on river flow levels. It includes the following items: clear statements on the responsibility for dam operations decision making and for the related emergency communications; maps outlining inundation levels for various emergency conditions; flood warning system characteristics; and procedures for evacuating threatened areas and mobilizing emergency forces and equipment. The broad framework plan and an estimate of funds needed to prepare the plan in detail are provided to the Bank prior to appraisal. The plan itself is prepared during implementation and is provided to the Panel and Bank for review not later than one year before the projected date of initial filling of the reservoir.

1. For example, a mine tailings, ash impoundment, or slag storage dam.

2. In the dam safety practice of several countries, the operation and maintenance plan includes both the instrumentation plan and the emergency preparedness plan as specific sections. This practice is acceptable to the Bank, provided the relevant sections are prepared and finalized according to the timetable set out in this annex.

Appendix- 1: TOR for Dam Safety Review Panel

Terms of Reference: Short Term Consultancy Expert Panel for Periodical Dam Safety Monitoring

Odisha Integrated Irrigation Project for Climate Resilient Agriculture (P 163533)

1. Introduction:

Government of Odisha is implementing the World Bank supported Odisha Integrated Irrigation Project for Climate Resilient Agriculture (OIIPCRA) through the Department of Water Resources (DoWR). The Govt. of India in the Department of Economic Affairs (DEA), in the Ministry of Finance, has approved the OIIPCRA on 23.2.2017. The cost outlay of the project is US\$ 230.62 Million (Rs. 1,560 Cr) out of which US\$ 161.44 Million (Rs. 1,092 Cr) is funded through World Bank assistance at 70:30 (Centre: State) cost sharing. The period of the project is 6 Years from 2019 to 2024.

The project is being implemented through the "Odisha Community Tank Development & Management Society (OCTDMS)", a Special Purpose Vehicle (SPV) created under the Department of Water Resources (DoWR), Government of Odisha.

2. Brief Report:

In the 1st phase of the project, 538 Nos. Of Minor Irrigation projects have been identified for rehabilitation in 15 Districts of Odisha in 4 river basins e.g. Rushikulya, Budhabalang, Baitarani and Tel Sub-basin covering about 56, 200 Ha. Out of the above there are 13 number of reservoir project (as per Annexure-I) having dam height equal to or more than 10 m and 9 (nine) out of the above 13 projects are coming under the purview of the Dam Safety Organisation as large dams.

The project authority on recommendation of the World Bank desires to bring the above 13 dams to be reviewed periodically by the Dam Safety Organisation of the State as being done for the large dams.

The Chief Engineer, Dam Safety, Odisha (DSO in short) will be the Nodal Office on the formation of Expert Panel for Dam Safety for OIIPCRA project.

3. Key Tasks:

- i. The DSO would form an Expert Panel of members who will inspect the dams as being done for the large dams as per standard prescribed by the State DSO.
- ii. The panel shall consist with minimum two member engineers, one from Hydrology and the other from Civil/Structural expert. The third member will be a Geologist.
- iii. The Expert Panel will visit at least once to all the above 13 dams in the first 12 (twelve) months of formation of the panel and submit their inspection and review through an interim report (for urgency if any) or a final report within 30 days of inspection.
- iv. The Expert Panel will also require to visit on request, the above 13 dams as and when warranted in case of urgency seeking for expert advice on safety measures. The Panel may also be requested to inspect any other dam beyond the above list coming under OIIPCRA, if situation warrants.
- v. The Expert panel will provide Yearly inspection report on health/safety precautions/ proposed measures along with any other information of importance for all the above 13 dams as per the format prescribed duly recommended by DSO.
- vi. The fees and expenses along with logistics shall be provided by the project authorities (OIIPCRA) as per the recommendation of DSO/ State Govt approved rates.
- vii. The expiry of the Expert Panel will be a maximum of 5 (Five) years from the formal acceptance of the proposal to be renewed every year by the project authorities.

4. Reporting Procedure:

- 4.1** Separate report shall be prepared by DSO/DSRP for each inspected dam and shall include, but not to be limited to
 - a. Assessment of the condition of the structure based on the visual observations and available data on the design, hydrology, construction, operation, maintenance and performance of the structure.

- b. Recommendations for any emergency measures or actions, if required to assure the immediate safety of the structure,
 - c. Recommendations for remedial measures and actions related to design, Construction, Operations, Maintenance and inspection of the structure, if required
 - d. Recommendations for additional detailed studies, investigations and analysis, if required
 - e. Recommendations for improvements in routine maintenance and inspection of dam, if required
- 4.2** The report shall be prepared by DSO/DSRP team jointly with in the block period of a visit, and each report shall be dully signed by every member of the DSRP team before its submission to the State Project Management Unit.

Sd/-11.3.2019

Project Director, OCTDMS-cum-
Additional Secretary to Govt., DoWR