



INTERVENTION IN EXISTING SPILLWAY GATES BY PROVIDING FLAP TYPE RADIAL GATE TO NEGOTIATE FLOATING TRASH

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ABSTRACT

Hydro Power stations regularly face increasing problems due to high quantum of floating trash particularly during Rainy seasons. This trash gets accumulated in front of Intake structure, clogging the trash rack panels, resulting in lesser power generation due to head loss and damages to the generating units. To negotiate the incoming trash, spillway regulation gates have to be opened frequently resulting in water loss and generation loss. In dams with crest type gates, it was deemed more efficient to provide a flap type opening over the main gate to flush the incoming floating trash & debris without the need of opening/ raising the main gate. This paper aims at describing various challenges related to the successful replacement of existing spillway radial gate with a new flap type radial gate while retaining major supporting structures.

1. GENERAL

Floating trash in the rivers worldwide is gradually becoming more severe with increasing population and urbanization. Negotiation of floating trash in the rivers is a huge challenge for efficient operation of hydro Power stations. These Power stations have to deal with a variety of debris, including aquatic weeds, plastic bottles and packets, wooden logs, and other waste materials. Dam control equipments must frequently remove the debris that would cause damage or operational difficulties at downstream facilities. Operation and maintenance problems associated with trash management result in huge cost implications each year in extra labor, equipment repair cost and generation losses. Focus of the paper is on the regulating structures and suggesting suitable modification for better trash management. This report discusses challenges encountered in modification, alteration and replacement of existing radial gate of the Salal Dam, J&K, India, with a new flap gate arrangement to be used for efficiently negotiating the floating trash.

2. DESCRIPTION OF EXISTING RADIAL GATE

690 MW Salal hydro power station is located in Reasi district of J&K, India. It's reservoir is built by construction of a rockfill dam across the main river source and a concrete dam. Right end of the concrete dam comprises six No. semi-octahedral Intake structures, feeding water to six no. generating units. To regulate the reservoir, 12 Nos. 15.24 x 9.33m sized crest type spillway radial gates are provided in the left end of the concrete dam. These gates, commissioned in 1991, are being operated by means of 135T capacity dedicated rope drum hoists placed on the hoist bridge at spillway deck. The gate structure consists of skin plate assembly with vertical stiffeners supported over three horizontal girders and six radial arms. These gantries are further supported over the steel trunnion beam fixed to the pier through pre-stressed anchorage system. The trunnion assembly was provided with aluminum bronze bushing. A hood is provided at upper middle portion of the gate above FRL to discharge excess water in case the water level rises above FRL. Shields are also provided in the both ends of the gate to protect the radial arms. General layout of the existing radial gate is as placed at Annexure - I.

3. REQUIREMENT OF A NEW GATE

Initially, it was thought that the flap gate shall be accommodated within the existing spillway radial gate. Given the existing gate height of 9.33m, introducing a flap gate of 2.0-2.5m size to negotiate the trash, the available clear height of the radial gate structure would be about 7.5m. In view of existing location of structural members e.g. 3 Nos. horizontal girders alongwith radial arms, it was not feasible to accommodate the flap gate and hydraulic cylinders within the existing configuration of the gate structure. Hence, it was considered appropriate to completely replace the existing gate with a new gate comprising 2 Nos. horizontal girders and 2 sets of radial arms. Accordingly, skin plate assembly was redesigned to transmit hydraulic thrust and support the flap type gate through two frames (comprising radial arms and horizontal girders). Sections of radial arms, limb plate and hub were revised so as to fit in the existing trunnion

assembly. Trunnion bracket was provided with self lubricating type bushing for maintenance free operation. The gate assembly was designed so as to fit in the existing civil interfaces. General Arrangement of the new radial gate assembly is indicated at Annexure – II. The new flap type radial gate shall be operated by rope drum hoist placed on the existing hoist bridge at spillway deck.

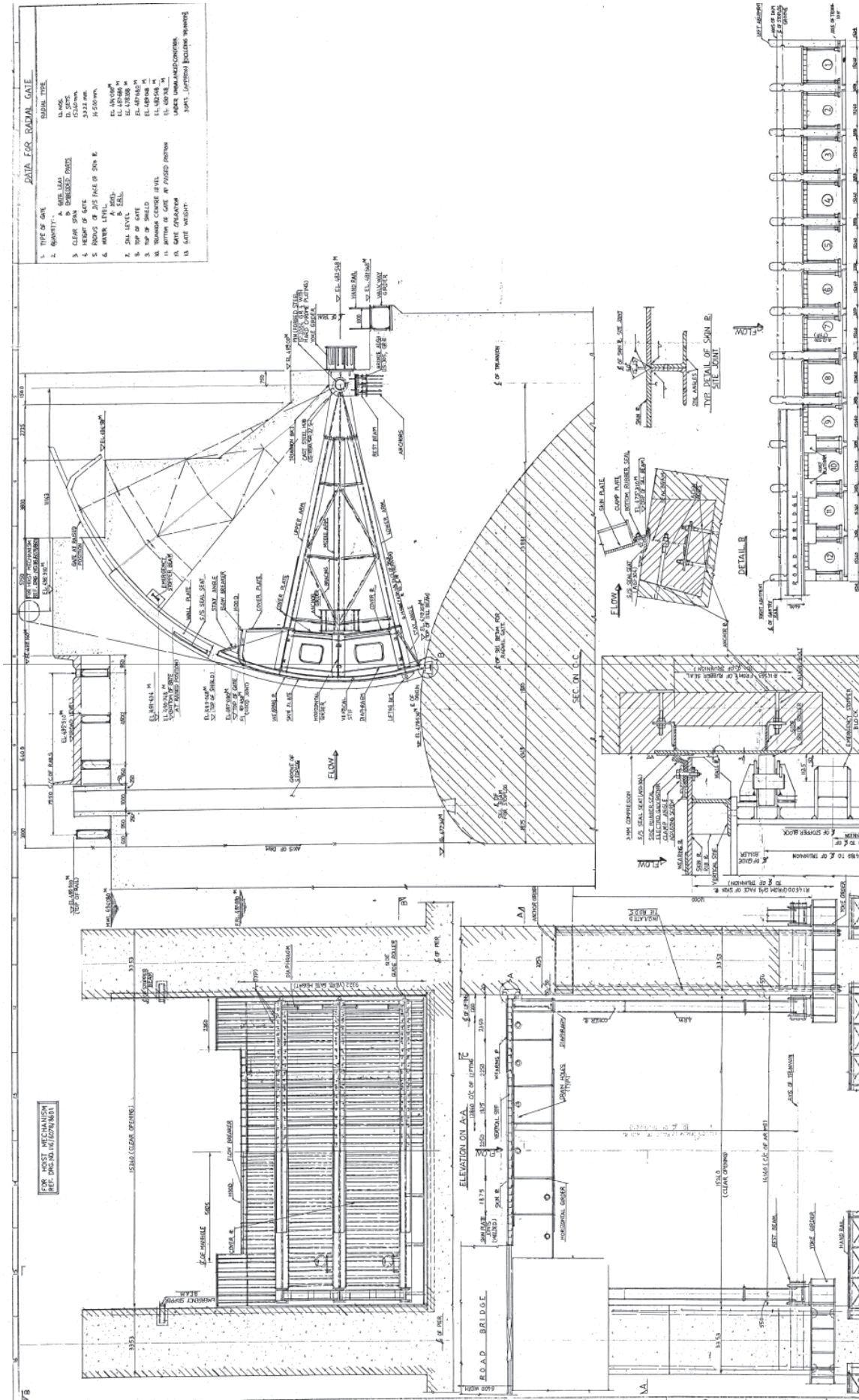
4. FLAP GATE & HYDRAULIC HOIST

The flap gate, provided in the new radial gate structure, shall be operated by means of hydraulic hoist. To accommodate the hydraulic hoist and flap gate over the limited available height of main gate (7.33m) and also to get optimum hoist capacities, location of hoist cylinders was meticulously planned. Hoist cylinders were attached to the gate body through “Cardenic suspension system”. Spherical plain bearings were provided in the cylinder suspension attachment to cater to slight misalignments during operation. Matching lifting attachments were also planned and provided. A sketch of the cardenic suspension system is attached as Annexure – III.

5. FABRICATION & INSTALLATION

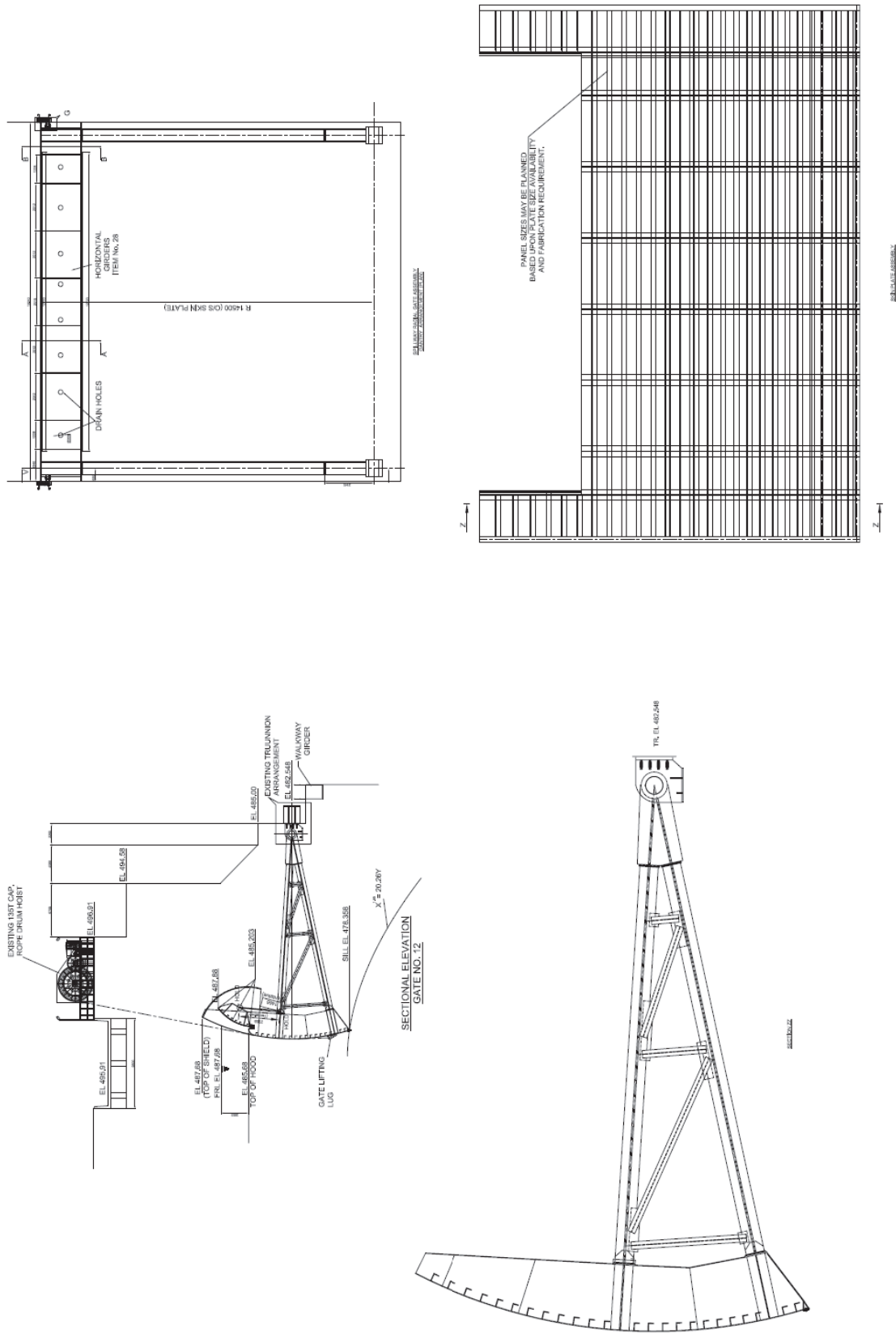
The fabrication and installation of the new radial gate with flap type opening (operated by means of hydraulic hoist) was carried out in accordance with the specification drawings and technical specifications. The new flap type radial gate was successfully commissioned in July 2019.

ANNEXURE - I



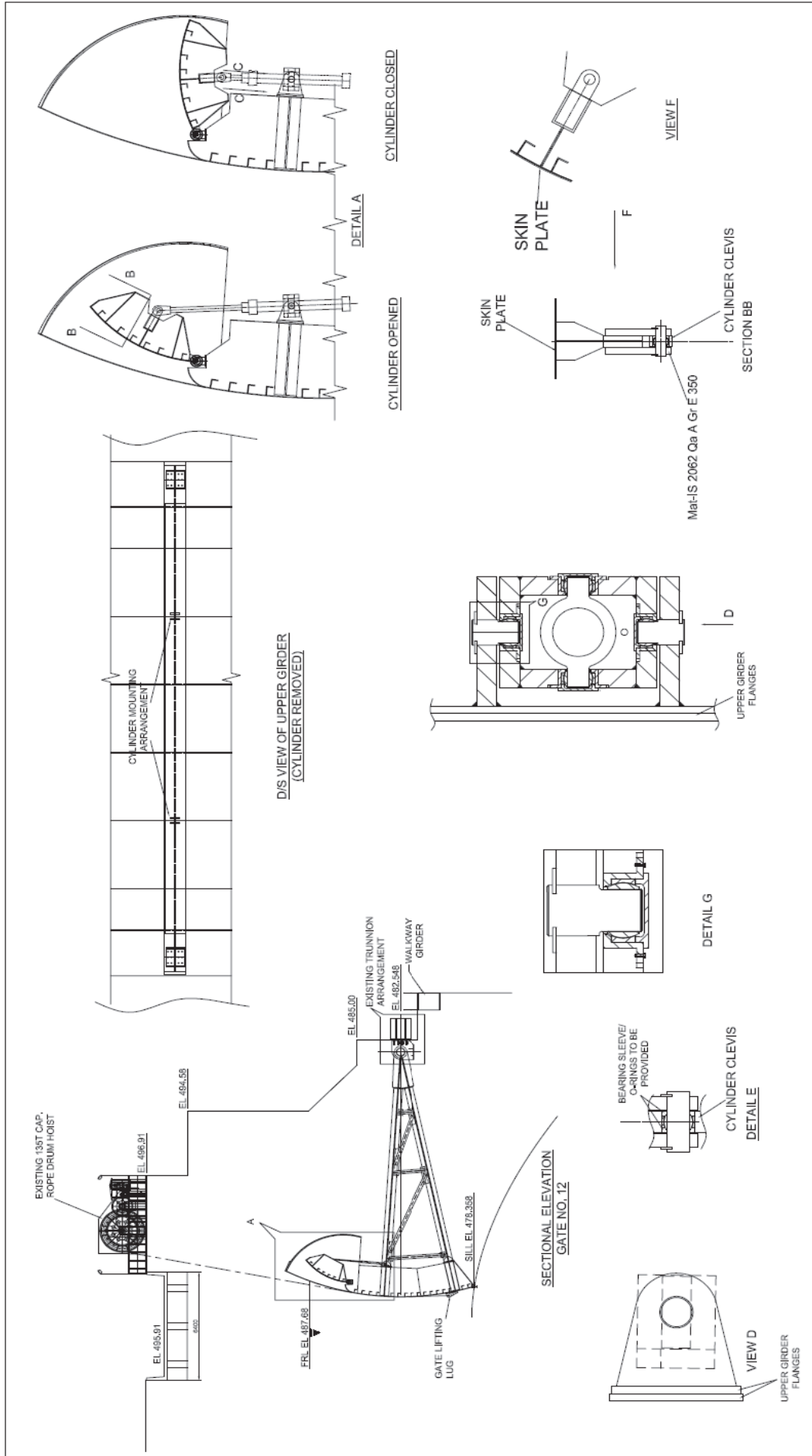
PREVIOUS RADIAL GATE ARRANGEMENT

ANNEXURE - II



NEW RADIAL GATE ARRANGEMENT

ANNEXURE - III



HOIST CYLINDER MOUNTING DETAILS



ARIAL VIEW OF SALAL PROJECT



D/S VIEW OF OLD RADIAL GATE NO. 12



D/S VIEW OF NEW FLAP TYPE RADIAL GATE NO. 12